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DISTRIBUTION SECTION.

Afternoon Session, Wednesday, October 21.

MR. C. E. REINICKER (Chicago), *Chairman,* Presiding.

MR. J. STILWELL (New York), *Section Secretary.*

The Chairman called the meeting to order at 2:07 P. M.

THE CHAIRMAN: The first paper this afternoon is "Welding of High Pressure Mains," by Mr. J. D. Shattuck, of Chester, Pa.

WELDING OF HIGH PRESSURE MAINS.

INTRODUCTION.

While the title of this paper is "Welding of High Pressure Mains," I shall review some points of high pressure distribution in the endeavor to make this paper a guide for the proper installation of what I believe to be the latest word in high pressure lines.

HISTORY.

The general practice of distributing artificial gas at pressures greater than 5 lbs. dates practically from 1899, when F. H. Shelton laid 5 miles of 3 in. pipe from Phoenixville, Pa., to Royersford, Pa., employing 30 lbs. pressure; this line being immediately followed by similar extensions in the Philadelphia Suburban district under direction of the writer, all of which is history and covered in gas proceedings and journals summarized in Appendix "A."

One criticism that can be made of the early installations is that the designers did not take full advantage of existing knowledge in the natural gas and oil fields at that time, and substituted inferior material and workmanship, trusting the purchase of material largely to jobbers, who took cheapness before quality, with the result that there are many very leaky high pressure lines.

The first high pressure lines were laid in many cases with ordinary light pipe, cast iron fittings and rubber packed expansion joints, which, following some natural gas practice,

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were supposed to take care of expansion due to temperature changes. Natural gas costs nothing to manufacture, and, therefore, leakage is not as important an item to the natural

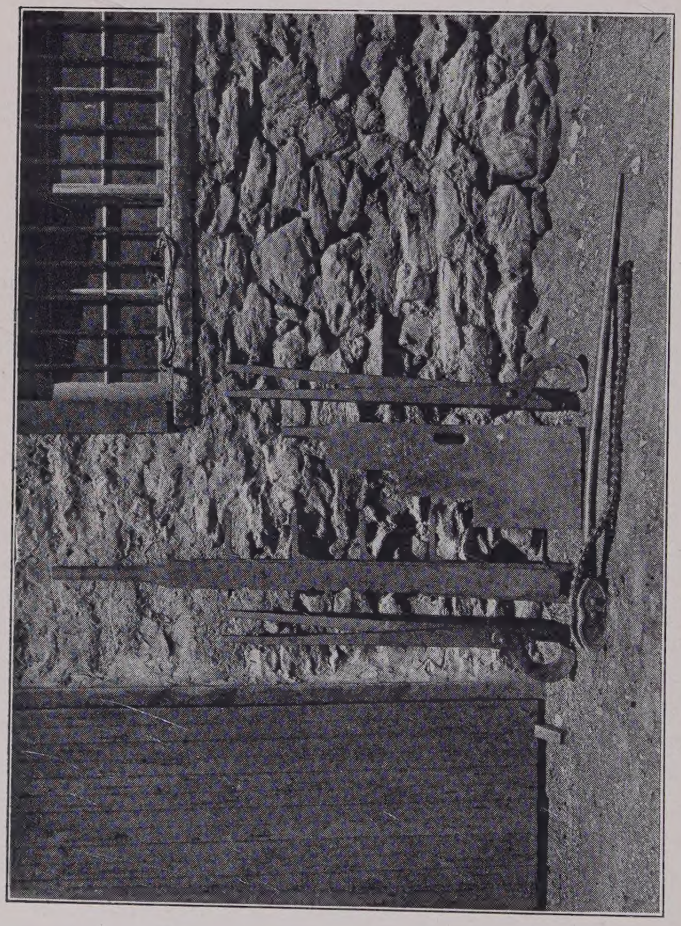


Fig. 1.—Jack, jackboard and tongs for use on screw joint high pressure line. Page 947.

gas engineer as to the artificial gas engineer, and rubber joints will last longer on natural gas lines than on artificial gas lines.

It has been found that cast iron fittings and expansion

joints will not do. Even eliminating these, leakage is still too great with the valves and plug cocks usually employed. With the best valves and screw pipe obtainable transmitting artificial gas at 45, 60 or 90 lbs., or higher, serious leakage will occur. Fig. 1 shows some tools used on screw pipe.

Every high pressure plant installed with 30 lbs. working pressure must soon, and rapidly, step up to higher pressures with the growth of the business. The writer feels that the only solution is to lay welded lines with welded drips, tees, etc., heavy steel hydraulic valves, welded pressure tanks and welded services.

When to Employ High Pressure.

A high pressure plant, 30 lbs. working pressure, designed to sell 25,000,000 cu. ft. or less per annum, would carry an additional operating cost of nearly 10 cents a thousand for compression, and an additional leakage of probably 10 per cent. above the normal of low pressure system, if screw pipe is employed. This would mean that on a plant designed to sell 25,000,000 a year, an engineer would be justified in spending $25,000 more than the cost of a high pressure system to make it low pressure, and if his gas cost him 40 cents a thousand at the holder, he could spend another $10,000 on plant investment, due to the saving in leakage.

When High Pressure May or May Not Be Employed.

1. Not if low pressure can possibly be used without too great capital expenditure.
2. Not if medium high pressure employing blowing units can be used.
3. Only when interest charges are greater than cost per thousand of compression over a term of years.
4. To connect widely separated plants.
5. To add or develop new towns (cut to low pressure at such towns if compactly built).
6. If passing through small towns, individual house governors can be used.

As sales increase and the capacity of compressors are reached, duplication and redesign of compressor stations become expensive and would pay for many low pressure mains.

TABLE 1.—HORSE-POWER REQUIRED TO COMPRESS 1,000 CUBIC FEET OF GAS.

At 15 lbs.	.....	50 H-P.
" 30 "	.....	85 " "
" 45 "	.....	111 " "
" 60 "	.....	134 " "
" 80 "	.....	117 two stage
" 100 "	.....	151 " "
" 200 "	.....	212 " "

There are many small high pressure installations that show leakage percentages of 20, 30 and even 50 per cent. of the amount of gas manufactured. There are installations being made to-day along improper lines, through which it is a question if a profitable gas business can be long maintained. The writer has seen plants designed in which the gas is compressed into tanks at 80 lbs. pressure in order to save holder expense, and then is sent out through a station governor to a low pressure system. The cost of compressing gas in this case was nearly 10 per cent. per thousand, which very soon would have paid for the difference between the compression tanks, compressor and a moderate size gas holder.

Compression tanks and condensers should be welded, as it is almost impossible to make riveted tanks absolutely tight, and a very small leak in a compression tank under 80 lbs. pressure amounts to a good deal in the course of a year.

200 POUNDS PRESSURE.

There are certain advantages in working at pressures even up to 200 lbs.—purification, for instance; sulphur all removed in the resulting condensate. (See E. C. Jones on "The Effects of High Pressure upon Illuminating Gas," 1906 PROCEEDINGS American Gas Institute, and *Proceedings* 17th Annual Meeting Pacific Coast Gas Association.) It is true candle-power losses are considerable, but extensive experiments given in

Appendix "F" show the B. t. u. losses at 4 to 5 per cent., while candle-power losses run from 25 to 35 per cent.

Two hundred lbs. pressure will make a high pressure system as elastic as the ordinary low pressure system. In designing a low pressure system, we provide for future years growth by the addition of small pressures, as four times the pressure on low pressure system doubles the output.

To double the delivery of a high pressure system, takes

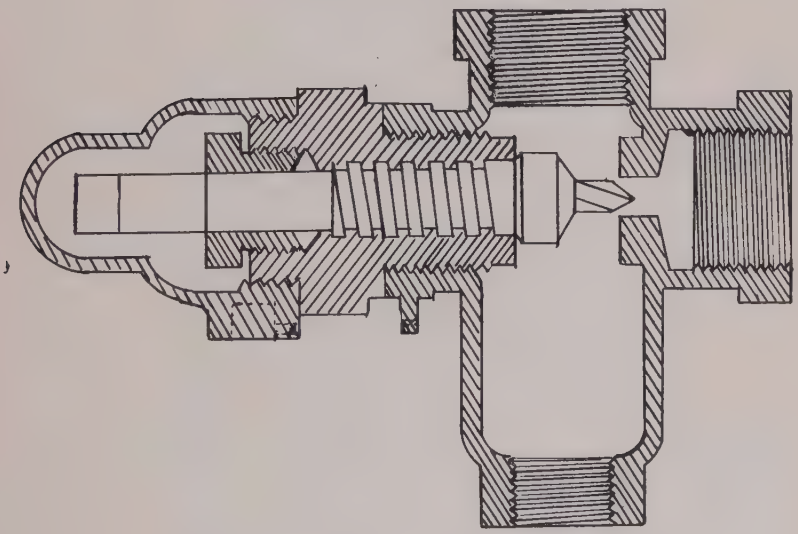


Fig. 2.—Improved service valve. Page 950.

three times the pressure; so a system designed to carry 30 lbs. pressure it is very likely will easily work up to 100 lbs. pressure to keep up with the growth of the territory. No screw pipe system will be tight enough for future proposed pressures.

In order to carry 200 lbs. pressure, welded joints must be substituted for screwed joints in mains and services. Strap saddles will not do, nor plug cocks. A special design of plug cock will answer for air pressure and is in daily use on all railroad cars, but the gas pressure is something entirely differ-

ent to handle, because the plug cock depends upon a film of grease for tightness. It will remain tight until the oil in the gas has destroyed the grease, then the cock will begin to leak.

It is proposed to substitute for the cock a steel or brass valve, similar to an ammonia valve, but provided with blank ends that can be welded instead of screw ends, the stuffing boxes of these valves to be packed with a soft lead packing, or a dry graphite packing upon which the gas has very little effect. So far the cost of these valves is high.

A source of danger are the fittings inside the customer's cellar. A new patent cock, Fig. 2, has been designed for this purpose. This cock, or rather valve, can be opened or closed

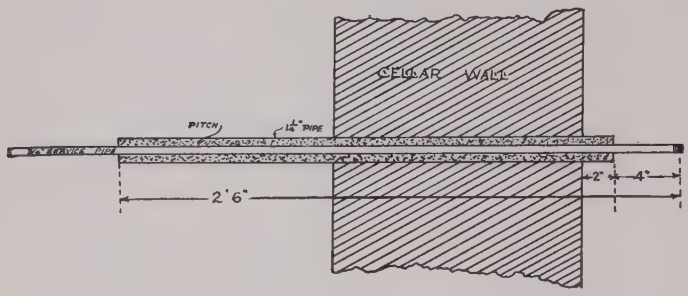


Fig. 3.—High pressure service pipe protector through cellar wall. Page 950.

without straining the service pipe, also can be repacked and cleaned out on the service. By using these valves, welding the services to the main, and welding the services themselves, there will be a bottle-tight system, without screw joints, into the consumer's cellar.

A plug cock sometimes becomes so stiff, that there is great danger of breaking off the ¾ in. service at the cellar wall in attempting to close it, especially after the pipe has become old and rusty. Protection to the service pipe is shown in Fig. 3.

Fortunately, the handling of high pressure gas has so far been practically devoid of any serious accidents, but these may be more frequent due to weakening of the pipe as the present

lines increase in age and the high pressure services installed during the last few years, grow old.

Leakage on Non-Welded Line.

I believe when the gas engineer comes to realize how great the leakage can become on a screw joint line, or a rubber expansion jointed line, that he will not be satisfied with anything less than a welded line. Leakage on a line carrying 30 lbs. or over is bound to be excessive on any screw jointed line with saddles and plug cocks, no matter how well the work may have originally been installed.

Eighty miles of high pressure line, put in several years ago by the writer, in which full weight guaranteed line pipe was used, and the best saddles and plug cocks obtainable, shows a leakage under 10 lbs. pressure between 1 A. M. and 4 A. M., at the rate of 98,000 cu. ft. per mile of 3 in., or 1½ lbs. loss at 10 lbs. per sq. in., and under 30 lbs. pressure the same hours, 165,000 cu. ft. per mile of 3 in., or 2½ lbs. loss at 30 lbs. per sq. in.

Generation of Acetylene.

A complete acetylene generating plant should be located in a small separate building conveniently located to the repair shops. When thus located, the gas may be piped directly to the benches and connections made for the torches. This plant will provide gas for working pressures up to 15 lbs. for shop use, and for compressing gas into cylinders up to 150 lbs. compression. The cylinders for the storage of the gas are specially constructed, and are filled with a porous substance and a solvent which has a remarkable property for absorbing 25 times its own volume of acetylene gas for each atmosphere of pressure.

One cu. ft. of acetone will, at one atmosphere absorb 24 cu. ft. of acetylene. At 250 lbs. pressure it will absorb 400 cu. ft.

Acetone weighs about 6½ lbs. to a gal. One gallon equals 0.1336 cu. ft.

Figuring from this, it will be seen that the acetone required for charging a cylinder of 12 in. x 36 in. would be 4.24 gal. or 27.56 lbs.

On each cylinder is stamped by the maker, the total weight including the weight of the acetone. Before refilling, the cylinder should be weighed and if found light the necessary acetone should be added to bring the weight back to that shown by the stamp.

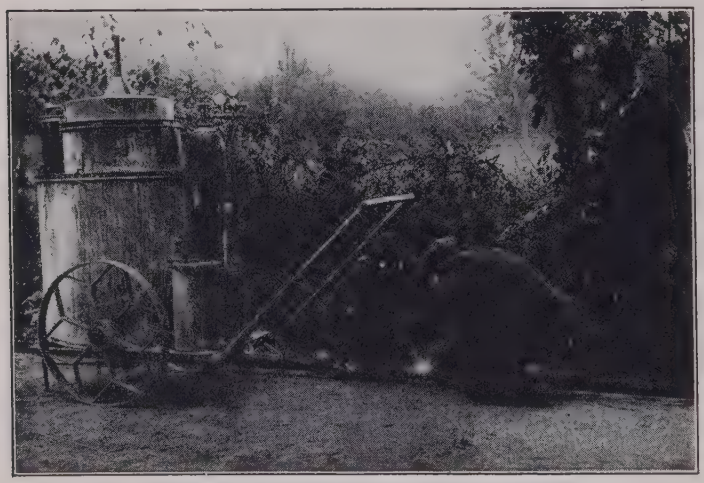


Fig. 4.—Generator for field work with the low pressure torch. Page 953.

Acetylene gas produced from a pound of carbide is estimated at 4½ cu. ft. The market price of carbide is about $70 per ton. This will show a cost of gas in the gasometer of about $^{8}/_{10}$ cents per cu. ft., of free volume and about 1 cent when compressed into tanks. Gas bought from a manufacturer would cost about 1¾ cents f. o. b. factory.

Autogenous Welding.

If a few general precautions are taken, there need be no danger in the production of acetylene. See Appendix "C" for characteristics of acetylene.

A complete plant for generating gas and compressing in tanks for shop and field work would consist of the following:

1 Generator, capacity 100 lbs. of carbide, producing 100 cu. ft. of acetylene per hour, using 1¼ in. x ⅜ in. carbide.
1 Acetylene gasometer, capacity 100 cu. ft.
1 Purifier, with full charge.
1 No. 1 Mechanical drier.
1 No. 2 Chemical drier, charged.
1 Oil separator.
1 Special three-stage acetylene compressor.

This would cost $2,500 complete, including one welding and cutting outfit as listed below.

It is the writer's opinion that for a small company, where the work is limited, the single units would be the most profitable way to handle the welding proposition, but that a complete outfit as given above would be a very good investment for a large company, and would probably be a good investment for a group of companies when the gas could be made at such a location as to be shipped without excessive transportation charges.

A generator used for field work, with a low pressure torch, is shown in Fig. 4. A similar apparatus was used to lay 7 miles of 4 in. at Concord, N. C.

Welding Outfit.

A single welding and cutting outfit consists of the following:

2 Compressed acetylene cylinders, size 12 in. x 36 in., capacity 225 cu. ft., weight, filled, 185 lbs.
1 Style "C" manufacturer's torch, with tips Nos. 1, 2, 3, 4, 5, respectively.
1 H. P. acetylene regulator.
1 L. P. oxygen regulator.
1 Oxygen cutting regulator.

1 Style "C" cutting torch, with 3 tips.
1 24-ft. length acetylene hose.
1 24-ft. length oxygen hose.
1 24-ft. length oxygen cutting hose.
2 pair of heavy smoked shielded glasses or goggles.

In order to complete the above outfit, it would be necessary to provide oxygen cylinders, which may either be purchased or will be furnished by the manufacturer of oxygen and loaned free of charge, for a period of one month, after which time a charge of 25 cents per week is made. The writer has found it advantageous to own at least two cylinders for each outfit. These cylinders contain 100 cu. ft. and as it requires about 1.14 cu. ft. of oxygen to one of acetylene for a properly regulated flame, it will be realized that at no time should less than two of these cylinders be on hand.

A cylinder with a capacity of 250 cu. ft. is made, but owing to convenience of handling, the smaller tank is preferred. The 100 cu. ft. cylinder cost $22.50 each.

In addition to the above equipment, a machine cutting torch with circular attachment would prove to be a very profitable addition, as with this torch a much more even and true circle can be cut out. This torch is particularly useful for shop work, where most of the flange and drip work for a line could be done in advance of the actual work in the field.

The cylinders as given above are a very good size to handle for ordinary work, but if the work in hand is of considerable extent, it would be better to substitute cylinders 16 in. x 48 in., which have a capacity of 500 cu. ft. and weigh from 350 to 400 lbs. filled.

Acetylene Torches.

In 1903, Fouché introduced the low pressure torch which works on the injector principle, much the same as a steam injector. The oxygen, admitted under a fairly high pressure,

draws in the acetylene. This torch is capable of using either dissolved acetylene or acetylene from either low pressure or high pressure generators. The pressure type, brought out the same year and known in the United States as the "high pressure" torch, introduces both gases under a pressure of a few pounds, consequently it must be supplied with dissolved acetylene, or acetylene furnished by a high pressure generator.

In the cutting torch, several small oxy-acetylene jets preheat the work for an additional jet of oxygen, which does the cutting by a high rate of oxidation. Part of the metal is removed as an oxide, and the heat of combustion melts the rest so that it runs out of the cut.

Theoretically, the proportion of the gases are 2 of acetylene to 5 of oxygen, which combines to form 2 volumes of carbon dioxide plus 1 of water. This reaction is not completed in the inner cone, the acetylene and oxygen burning to only carbon monoxide and hydrogen. These cannot combine with more oxygen in the inner cone, because the temperature is above their dissociation point, so further combination occurs in the outer envelope.

Most of the oxygen in this second step is taken from the surrounding air. The tip of the inner cone is the working point of the flame. Although its total heat is less than that of the outer envelope, the outer being very much larger, the heat in the envelope is not wasted. Instead, it serves three functions, viz., to preheat the work for the inner cone, to prevent the inner cone from being cooled by the inert nitrogen of the air, and to protect the molten metal from oxidation, the combining carbon monoxide and hydrogen having a greater affinity for oxygen than the metal.

Every gas works should be equipped with the oxy-acetylene welding and cutting torch, and carry on hand tanks of oxygen and acetylene. These tools come in very handy for making welds for various pieces of machinery, retort doors, broken lamp posts, automobile repair shop and numerous other jobs.

Another use for the cutting torch is cutting of not only the pipe on the job, but any other large pipe cutting that is required about the plant. To cut an 8 in. pipe with pipe cutters oftentimes takes 15 to 30 minutes, according to the position it is in, whereas with the cutting torch it can be done in 2 minutes.

There are several makes of torches on the market, any of which will do good work. However, on account of their convenience for field work, the writer's reference will be confined to the "Medium or High Pressure Torch." These torches are classed as the C. & B. torch.

The style "C" cutting torch is a 2-base model, a by-pass valve supplying the extra cutting jet of pure oxygen, the valve being opened or closed by a slight movement of the thumb. This torch is convenient to handle, light in weight and constructed with a view to the greatest durability and efficiency.

Our standard welding torch is the style "C" manufacturers' torch. This torch is furnished with tips No. 1 to No. 5 and will weld metal from 1/32 in. to 5/16 in. thick. Tips No. 6 and No. 7 can also be procured to fit this torch and this will enable thicker metal to be welded with this comparatively small torch.

For heavy welding the large style "C" torch should be used, which comes with tips No. 6 to No. 10, and will permit of welding metal above 5/16 in. thick.

The style "B" welding torch is very efficient and economical in operation, and many of the most economical results in oxy-acetylene welding have been accomplished with it. It is made in 2 sizes, for light and heavy welding, and each size fitted with 5 tips of varying capacity for different thicknesses of metal. A melting attachment may be used with style "B" torch, thus making of it a combination torch. Two oxygen regulators and 2 separate lines of oxygen hose are used. One provides the oxy-acetylene flame, and the other for the pure jet of cutting oxygen.

The oxygen for the combustion of the gas is compressed in cylinders 7½ in. in diameter by 48 in. high, they being charged to a pressure of 1,800 lbs., and weighing 122 lbs. when filled. Another cylinder, known as the low pressure cylinder, is 15 in. in diameter by 51 in. high, is charged to 300 lbs. pressure and weighs 175 lbs. The oxygen in these cylinders may be purchased from a central station, no charge being made for the use of the cylinders unless retained beyond the specified time.

For field use a specially constructed acetylene tank always containing acetone is used in which the acetylene is compressed to 150 lbs. pressure.

The gas has a heating value of 1,658 B. t. u. and will require 2½ times its volume for complete combustion.

Suitable regulators and reducing valves are provided for the tanks in order to reduce the acetylene and oxygen to any desired pressure.

The welding rods used should be carefully selected and be the best Norway or Swedish iron.

A complete generating and welding outfit is given hereafter in detail.

Welders.

Good welders can be made out of any men of fairly mechanical turn, blacksmith's helpers, or fitters or helpers that have worked on gas furnaces, and have a little idea of heats. This class of work does not have to be as well finished as the usual shop jobs, so that professional welders are not required.

A smart laborer soon becomes very expert in the use of the torch, and is able not only to make joints without pressure in the line, but to weld on service connections and weld sleeves over existing expansion joints with 35 lbs. pressure in the mains without burning holes through the same.

The first few joints will be rather expensive, but we have found that the men as they become familiar with the process gain rapidly in the amount of work they can do. Our experi-

ence in 1911 showed that an experienced welder can do 4 4 in. joints per hour. Mr. E. C. Jones, Chief Engineer, Gas Department, Pacific Gas and Electric Company, San Fran-

Fig. 5—4-inch welded line. Page 961.

cisco, Cal., gives 25 4 in. joints as an 8-hour working day; this would be 1,000 ft. of pipe 40 ft. lengths per man per day. On 2 in. joints, we have welded as high as 12 joints per hour,

and individual 2 in. joints in 2½ minutes. Mr. Jones has given costs covering sizes up to 16 in.

Fig. 6.—Welding a tee on the under side. Page 961.

Pamphlets and books of use in study of autogenous welding are:

"Oxy-acetylene Torch Practice," by J. F. Springer.

"Welding and Cutting Metals by Aid of Gases or Electricity," by Dr. L. Groth, 1913.

Fig. 7.—Welding apparatus as used on 4-inch line. Page 961.

"Welding Theory, Practice, Apparatus and Tests; Electric Thermit and Heat Flame Processes," by Richard N. Hart, 1914.

"Welding and Cutting of Metals in the Gas Industry." Paper read before the Illinois Gas Association, March 18 1914, by H. P. Harding.

"A Pratcical Manual of Autogenous Welding with a Chapter on Cut-

ting of Metals with Blow-pipe." Translated from the French and published in London in 1913.

Bulletin No 45, on "The Strength of Oxy-acetylene Welds in Steel," endorsed by the University of Illinois. See resume Appendix "D."

Magazine called "Autogenous Welding," printed in 1911.

Acetylene Journal Publishing Company, 440 S. Dearborn Street, Chicago, Ill.

Welding of high pressure mains was started by an English engineer in 1911 or 1910, and there was an article published in the *Gas World* (February 4, 1911) in which the possibility of supplying gas at 90 to 200 lbs. pressure was suggested. Figs. 5, 6 and 7 are photographs taken of the first welded high pressure installation in this country for distribution of high pressure gas. This was a 4 in. line, laid by the writer in July, 1911. The process was brought to his attention through the welded steam headers that were being installed in steam plants and notices in the foreign papers that street mains were being welded in Germany and France, and about this time in England. Since that date, we have extended the uses of the process, but the work has been largely confined to small sizes, as there has been no trunk line work required.

Welding Pipe.

Pipe in 40 ft. lengths is now available, both I. D. and O. D. The method of proceeding with the welding of pipe is simply the rolling of lengths and butting of the ends together in a fairly straight line. This can be done on a smooth roadway or on skids over the trench. After a few lengths are welded together, the skids may be removed from the point of beginning and the pipe slowly reeled into the trench as the work proceeds, or the pipe can be welded in sections with two or more gangs working at the same time, then dropped into the trench, and the final connection welded in the trench.

The more snake-like horizontally the pipe is laid in the trench, the better, as it will tend to relieve what contraction strains may occur later. The pipe should be carefully graded, however, as in low pressure work.

No care is necessary in dropping the pipe into the trench.

The weld is as strong or stronger than the pipe itself, and if the falling of the pipe into the trench is going to break a bad joint, obviously, we are glad to discover such defect.

The advantage of welding on top is that the pipe can be slowly turned, thus enabling the welder to always work on the upper diameter of the pipe. The pipe can be welded underneath if necessary, as the fluxed material does not tend to drop, but tends to hang to the pipe. By placing chain tongs on the pipe, there is no difficulty in obtaining twist enough in the pipe to get sufficient roll, either forward or back, to make welding easy.

The end of pipe 2 in. and above should be slightly chamfered about 30 deg. from the diameter of the pipe, so that when the ends of the pipe are butted, there is a "V" formed. This "V" should not be more than ¼ in. across the top. As the thickness of metal becomes greater, a good rule to follow would be that up to plates of ¾ in., the width of this "V" should about equal the thickness of the metal to be welded, but beyond that, the opening would not need to be in quite the same ratio.

Chamfered pipe can be purchased at an additional cost per length of 3½ cents for 2 in., 4¼ cents for 3 in., and 8 cents for 4 in. pipe. To offset this, there is a 2½ per cent. saving in cost of plain end pipe over screw end and coupling.

In welding two ends of pipe together, Norway iron is used. It is necessary to make the pipe fairly straight to weld a small portion on one side of the pipe, and then a small portion directly on the opposite side, thus tacking the pipe together and then completing the weld.

A welder and two assistants, the assistants to roll the pipe, are all that is required to make the joint of ordinary sizes. After the completion of the weld, the welder, by means of a small hand truck, moves his two tanks forward to the next job, while the helpers are rolling the next pipe into position. We have designed a small galvanized truck, which can be

locked at night, and shades the tanks from the hot sun during the day. See Fig. 8.

In extending a main from existing gas lines, there is little

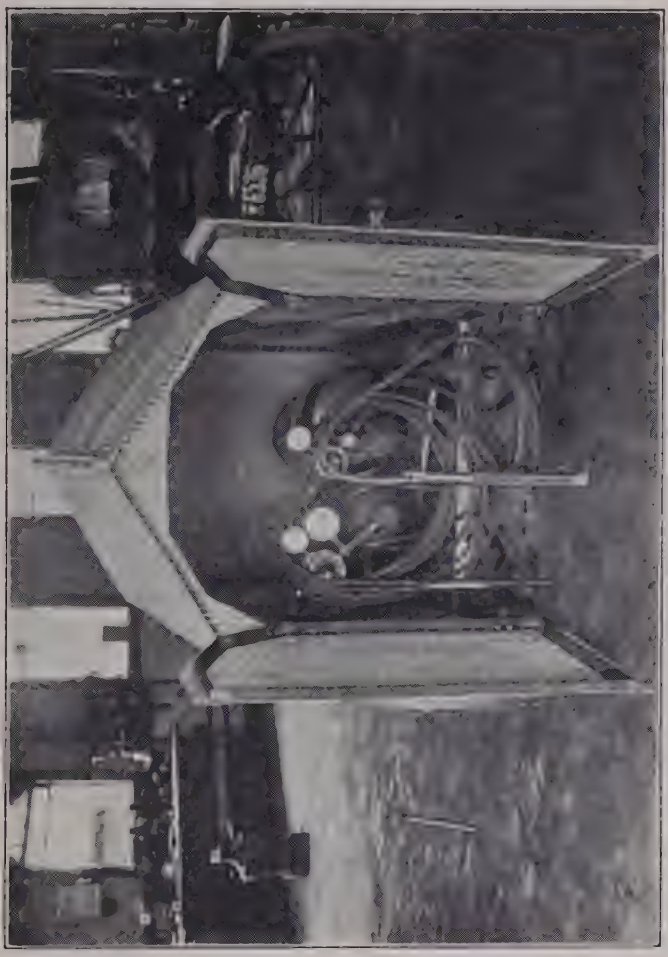


Fig. 8.—Complete welding outfit for street work. Page 963.

danger of explosion when the main is below 6 in., but for this size and over, care should be taken. Before making a final weld for a connection of this nature, it would be well to fill

the line with gas and bag the gas off each side of the weld, thus making a very small section of pipe that may possibly contain an explosive mixture.

The process of welding one pipe to another is very simple. Connections to the blow-pipe are made from cylinders of compressed oxygen and acetylene which carry pressures up to 1,800 lbs. and 150 lbs. respectively, the pressures being reduced by regulators and reducing valves to pressures for the different sized tips and thickness of metal as shown in Table 2 for welding, and as shown in Table 3 for the cutting torch:

TABLE 2.—APPROXIMATE ACETYLENE AND OXYGEN PRESSURES FOR STYLE "C" WELDING TORCHES.

Tip No.	Acetylene Lbs.	Oxygen Lbs.	Thickness of metal
1	1	2	1/32″–1/16″
2	2	4	1/16″–3/32″
3	3	6	3/32″– 1/8″
4	4	8	1/8″ –3/16″
5	5	10	1/4″ –5/16″
6	6	12	5/16″– 3/8″
7	6	14	7/16″– 1/2″
8	6	16	1/2″ – 5/8″
9	6	18	5/8″ upwards
10	6	20	5/8″ upwards

TABLE 3.—APPROXIMATE ACETYLENE AND OXYGEN PRESSURES FOR STYLE "C" TWO-HOSE CUTTING TORCH.

Tip No. 2		Tip No. 3		Tip No. 4	
Acetylene Thickness of metal	2 to 3 lbs. Oxygen pressure	Acetylene Thickness of metal	3 to 4 lbs. Oxygen pressure	Acetylene Thickness of metal	4 to 5 lbs. Oxygen pressure
¼″	10 lbs.	1″	20 lbs.	3″	40 lbs.
½″	20 "	1½″	30 "	4″	50 "
¾″	30 "	2″	40 "	5″	60 "
1 ″	30 "	3″	50 "	6″	70 "
1½″	40 "			7″	80 "
				8″	90 "
				9″	100 "

* H. P. Harding in his paper before the Illinois Association, March 18, 1914, gives considerable data on the theory of the oxy-acetylene flame and mentions a number of practical uses of this appliance.

There is a small pamphlet sent out by manufacturers called "Autogenous Welding," which gives much information on various uses of the oxy-acetylene torch.

Welding Service Connections Under Pressure.

To make a service connection to the main, a socket can be used, one end of which has been turned or ground to approximate radius of the pipe, and although this is not absolutely necessary, material will be saved by doing it. See Fig. 9.

Special sockets and tees will probably eventually be made for this purpose. When making a service connection, if it is being made to a new main that has been tested for leaks by

Fig. 9.—Welded service connection. Page 965.

gas pressure, it would be necessary to thoroughly purge the main before the flame from the torch is brought in contact with the pipe.

After the socket has been welded to the main, the main can be tapped by the use of the corporation cock in the usual manner. The service then can be run to the cellar, each length being welded the same as in the main work.

If a small hole is burned in the main, ream it out and drive a steel plug in the hole, and with a little care it may be welded over.

Fig. 10 is a photograph showing service connections welded

Fig. 10.—Service connection tests. Page 966.

to a 4 in. main at various pressures up to 35 lbs. The figures on the cards show the pressures in pounds under which the various connections were made.

To make sure there is no leak in the welding of the socket to the main, the latter can be connected to the oxygen tank and pressure put on the socket, or a cylinder of compressed air can be carried for testing services. A number of interesting experiments were made to determine the effect of burning holes through the main. With a small hole, the gas was easily extinguished by the use of a wet blanket. With a large hole, where the flame spreads so that it is not safe to approach close to it, a piece of 4 in. or 6 in. pipe, large enough in diameter to cover the hole, and 12 ft. to 15 ft. long, is held upright over the flame, combustion then taking place at the end of the pipe. The pipe can be thrown over quickly or moved horizontally away from the line, thus carrying the flame with it and extinguishing the fire at the main.

A 1/8 in. hole in the main at 3 lbs. pressure will blow out the low pressure torch. A 1/4 in. hole requires about 10 lbs. to blow out the torch.

Sleeving High Pressure Mains.

We are at present welding over our rubber joints, which, in some of our early lines, were put in every 500 ft.

The following method can be employed for removing expansion joints: If the joint is in the field, or under inexpensive pavement, 30 ft. of the line should be uncovered, the ex-

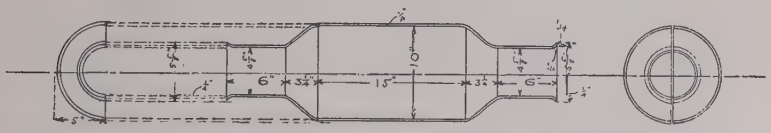


Fig. 11.—Split sleeve for covering leaky expansion joints. Page 969.

pansion joint taken off, the line raised, a sleeve of the proper length and of the next half size of pipe slipped over one end, the pipe lowered, and the sleeve slipped so as to cover the opening. The sleeve should then be caulked with asbestos wicking, and a slight gas pressure permitted to come against the joint, care being taken to purge the line of air. The ends of the sleeves should then be welded to the main. In case the

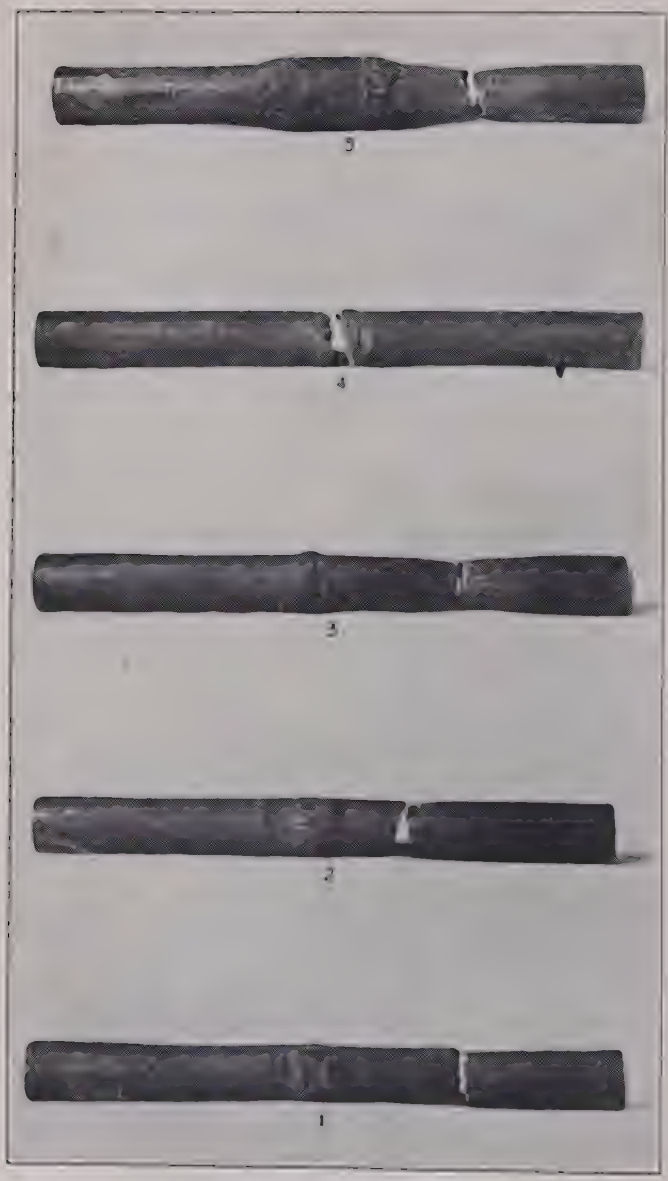


Fig. 12. Page 969.

line is under asphalt or expensive pavement, the split sleeve shown in Fig. 11 can be employed. With this steel sleeve, the expansion joints may be completely covered.

The sleeve is welded horizontally, first on one side, then turned and welded on the other, and then completed at the ends without interruption of service.

Strength of Welds.

The Testing Bureau of Swarthmore College made a number of tests for us of pieces of pipe welded in the field by our men

Fig. 13.—Welded joint sawed through longitudinally. Page 970.

without any special care. They were joints as they ran. Fig. 12 is a photograph of these test joints. It will be noted that four out of five of these joints were stronger than the pipe itself.

Appendix "B" contains a description of these tests, which

show two things: Not only that the weld is stronger than the pipe, but that the stretch in the pipe without rupture is a great many more times than any possible temperature contraction force that would occur to this pipe after it was welded and in the ground. In other words, no provision need be made to take care of temperature contraction in a welded line as far as the line itself is concerned. If steel valves are used, the valves will stand the strain. The bolts, however, that bolt the flanges to the valves may stretch enough to cause a leak unless some provision is made at this point. Slack should be forced into the line at and near valves. The best way to make sure that such extra length has been forced into the line is to lay the line, bolting the valve flanges together without the valves, and then lifting the line back of the proposed valve location until the flanges are separated far enough to insert the valve. After inserting the valve, drop the line back into the trench. Fig. 13 shows longitudinal sections of one joint. Notice especially the solid metal through the joint.

Expansion and Contraction.

According to the Bureau of Standards at Washington, the coefficient of expansion of welded boiler tubes between 0° C. and 200° C. was found to be:

Charcoal iron	0.00001235
Bessemer steel	0.00001258
Seamless O. H. steel (hot finished)	0.00001239

The expansion of lengths of 100 ft. pipe, given in table of *Practical Engineer,* January, 1911, up to temperatures and including 125° F., are as follows:

Temperature	Cast iron	Wrought iron	Steel
50° F.	0.36″	0.40″	0.38″
100° F.	0.72″	0.79″	0.76″
125° F.	0.88″	0.97″	0.92″

The physical properties of ordinary steel pipe are as follows:

Tensile strength	52,000 to 62,000 pounds per square-inch.
Elastic limit	Not less than 30,000 " " " "
Elongation in 8″	" " " 20 per cent.
Reduction in area	" " " 50 " "

A test piece, cut lengthwise from the pipe, filed smooth on

the edges, should bend through 180 deg. with an inner diameter at the bend equal to the thickness of the material, without fracture.

The tests made by Swarthmore College, as shown in Appendix "B," shows that the pipe that we have welded is about in accordance with above figures. From these figures it will be readily seen that the contraction of a long length of pipe would have to occur at one point to cause a rupture of the pipe. Therefore, I feel that we are fully justified in not providing for expansion in laying welded lines under ordinary conditions, where the temperature changes at 3 ft. below the ground cannot be greater than 32 deg. minimum and 75 deg. maximum, a range of only 43 deg.

We have used lead gaskets under service saddles and between valve flanges. Welding the service to the main will do away with these lead gaskets. In very cold climates where the frost gets down to the saddle, every year a number of companies have had leaks at this point, and outside of the money saved, I believe welding of services will do away with another element of leakage. It is a question whether the gaskets used on the valve flanges should not be of some other material than lead. This is the only point where we have not thoroughly eliminated the possibility of leakage on the mains. Companion valve flanges are made up with short pieces of pipe welded to the flanges to avoid screwed joints.

On the services, in order to carry high pressure above 30 lbs., it will be necessary to substitute valves in the nature of ammonia valves in place of plug cocks. We are having a valve made that will enable us to dispense with the swing joint and thus eliminate nearly all thread joints at the connection, as well as the troublesome plug cock.

Bending.

Wrought iron or steel pipe 12 in. and smaller can be bent cold in the field, provided the radius of the bend is not less than the table given below. Any radius less than this is apt to cause the pipe to buckle.

Size of pipe (Inches)	Advisable radius-R (Inches)	Minimum radius-R (Inches)
2½	15	10
3	18	12
3½	21	14
4	24	16
4½	27	18
5	30	20
6	36	24
7	42	28
8	48	32
9	54	36
10	60	40
11	66	44
12	72	48
13	84	60
14	90	68
15	100	76
18 O. D.	125	90
20 O. D.	158	120
22 O. D.	165	132
24 O. D.	180	144

Samples of bent pipe are shown in Figs. 14 and 15.

Metering.

There are three methods of measuring gas at high pressure that promise fairly accurate results. One, the Pitot tube, equipped with recording gauges from which quantities can be calculated, and the later development, which gives direct readings.

The Thomas electric gas meter, which is commonly known as the Thomas meter, without going into technical details, is one in which the gas, as it passes through, is heated a certain number of degrees by means of electric heating coils, the amount of current required to maintain a constant differential in temperature being proportional to the amount of gas passing. In order to accomplish this result, it is necessary to have on the inlet and outlet of the meter, thermometers, which consist of ordinary electric couples connected to a controlling device, which, by means of a reversing motor, throws more or less resistance into the circuit controlling the amount of

current passing through the heating coil. This current is measured, and shows directly the gas passing in cubic feet on an ordinary watt meter dial.

Fig. 14.—4-inch pipe bent with weld in the bend. Page 972.

In addition to the indicating meter, there is a graphic meter, which shows the rate per hour of gas passing. This meter has the additional advantage that you are able to place the

meter body, including the thermometers and heating coil, in the line of pipe outside of the meter house, simply running the wires in conduits into the regular works office, thereby doing away with an elaborate meter house.

Fig. 13.—Short pieces of 2-inch pipe welded together and then bent. Page 972.

Theoretically, the meter seems to be much more accurate than the ordinary wet station meter, and when a few of the minor difficulties have been overcome, it ought to be the meter for universal use.

The high pressure rotary meter automatically measures, integrates and records the free column of gas passing through the meter under varying high pressures.

The mechanism of this meter is operated by a turbine wheel, which is revolved by the passage of the full volume of gas over its vanes at a speed proportional to the column. Beneath the turbine is a pressure controlled valve, acting similar to the float valve of the governor, actually floating in the gas current, which regulates the volume of gas passing to the vertical ports under the turbine wheel.

The shaft of the turbine wheel is geared to another horizontal shaft in such a ratio that there is one complete revolution of this secondary shaft for every 100 cu. ft. of volume passing through the meter. This secondary shaft drives the recording mechanism.

The integrating mechanism is controlled by an ordinary pressure gauge connected to the pipe line and, therefore, sensitive to every pressure fluctuation. The pointer of this gauge carries with it around the dial, in its movement under varying pressure, a light arm turning in jeweled bearings. There is an automatic multiplication and registration of free volume at the end of every 100 cu. ft. flow indicated by the meter, regardless of the frequency with which these 100 cu. ft. volumes succeed one another—in other words, regardless of the rate of flow or delivery. The multiplication which transforms pressure volume into free volume is determined by the line pressure indicated on the pressure gauge at the instant of registration.

Tests of this meter under working conditions, by the writer, have shown very good results.

Pipe Sizes.

Cox's formula is good for working pressures up to 30 lbs. The Pittsburgh formula for calculating deliveries in comparatively short distances, and the Oliphant formula for large quantities and heavy pressures. See report of Committee on

Flow of Gas through Pipes, 1905 *Proceedings* Ohio Gas Light Association.

Screw pipe may be employed up to a maximum of 30 lbs. Pipe to be full weight recessed sockets, known as line pipe. No expansion joints. See, for further details, Specifications, Appendix "E."

Costs.

Mr. L. B. Jones, Engineer of Distribution, Pacific Gas and Electric Company, gives a comparison of the cost of welding an 8 in. line and a line laid with couplings, as follows:

	Feet	Labor	Material supplies sundries	Teaming	Total	Cost per foot
8″ O. D. Welded	4,770	$2,305.59	$2,609.55	$125.00	$5,040.14	$1.06
8″ O. D. with joints (rubber gaskets)	4,350	$2,527.70	$2,476.55	89.00	$5,093.44	$1.17

Mr. Jones tested the welded 8 in. line for 36 hours at 150 lbs. pressure without loss of pressure.

During the installation of the jointed line, laborers received $2.50 per day, but on the welded line, they were paid $2.75 per day, an increase of 25 cents per day per laborer.

From the foregoing comparison, it will be observed that the welded main was installed at 11 cents per foot cheaper than the jointed main, making a net saving of $524.70 on a small installation. Owing to the disintegration of the gasket, the jointed main will require maintenance, with the necessary labor and repaving cost added, while the welded main will never require any further attention or further cost.

Our welding costs on 4 in. and under have not been very different from screw pipe, principally because the runs were short and not much opportunity to work up to speed. A recent 4 in. line, 7 miles long, was run for the Concord Gas Company, Concord, North Carolina, under my direction, and the cost was very low, largely due to the employment of digging machinery. Outside of cost, the saving in leakage is going to be a big operating item. On 6 in. and larger, the pipe gang saving is considerable.

An ideal day's work on 4 in. pipe is 1,000 ft., employing 13 men and 1 foreman, 2 employed on a trenching machine, 3 with the welding outfit, a road roller equipped with a scraper and 2 men, 1 man following with a tamping machine, and 5 extra men to clean up and lower pipe from time to time, vs. the old way,—50 laborers, 2 foremen, and the work not so well done. Small companies who are not justified in maintaining the above plant can contract for its use, and save money and labor troubles over hand digging.

Troubles.

The troubles of a high pressure system come when the capacity of the line is being approached. The liquid hydrocarbons, if not removed at the plant, form in pockets in the mains sometimes, irrespective of drip locations. These liquid hydrocarbons as they get further away from the plant, begin to dry out and leave a fine black powder, practically a free carbon mixed with some iron and perhaps naphthalene, and form stoppages in mains and services. The gas also suffers a loss in its B. t. u. and candle-power, due to compression and transmission. (See Appendix "F" for tests made in compressing and transmitting coke oven gas.)

It is very easy to enrich high pressure gas at distant points. With a fall in pressure, the gas will pick up light oils at comparatively low temperature (40 and 45 deg.) after a drop of 10 to 20 lbs. in pressure from an initial 30 lbs.

The distribution troubles are confined, as a rule, to the governors getting out of order, which generally means simply the renewing of the disk or seat of the governor. This is discovered through complaint made by the customer, either from low pressure or blowing pressure, which blows a safety seal on the governor. The trouble with individual governors is more than offset by the uniformly satisfactory pressure that can be given to the customer, also different pressures can be given for different industrial uses. There is a big future for high pressure lighting, in which event compressed gas will aid.

An emergency outfit for handling high pressure breaks or

leaks should be kept handy to an automobile, so that high pressure complaints can be taken care of very promptly. High pressure demands more alert handling than is generally given to low pressure.

Conclusion.

New methods and wrinkles are being discovered almost every day, and there is no doubt but that we have entered upon a new method of laying high pressure gas mains, and that pressures will tend to increase in high pressure work as they have in low pressure in the past. The saving in leakage alone will justify many heretofore unprofitable extensions.

In Appendix "E," under "Specifications," further details are more carefully explained, and it will be noted that a number of changes in methods of doing work, due to the employment of the welded joint, will be found.

Considerable credit for the experiments and developments of high pressure work so far, should be given to a number of my assistants. I mention particularly Mr. Charles Wilde, Engineer of Mains of the Philadelphia Suburban Gas and Electric Company.

APPENDIX "A."

Paper by F. H. Shelton, at the International Congress of Gas Engineers, Paris, France, September, 1900.

Louisville, Kentucky, for about 2½ years pumped gas 2¾ miles through a 10 in. W. I. pipe at the rate of about 140,000 cu. ft. per hour, initial pressure 5 to 7 lbs. to fill gas holders, throwing a pressure of 10 in. No services from line.

Oakland, California, for about 10 years, a mixed coal and water gas pumped by piston compressor a distance of 8 miles to Alameda, through an 8 in. cast iron pipe with lead joints, also to fill an outlying holder. Initial pressure 5 lbs., terminal pressure 4 in. No individual consumers are taken off the line, although midway a line is taken off at E. Oakland, in which the pressure is controlled by a Connelly governor.

In Chicago, Illinois, for some years water gas pumped a dis-

tance of 23,000 ft., through an 8 in. pipe for the purpose of filling outlying holders. Using rotary exhauster of Root pattern. Initial pressure 10 lbs. passing 60,000 cu. ft. per hour into a holder against a pressure of 7½ in. No consumers.

In Danbury, Connecticut, for 10 years past a 35 candle-power oil-water gas has been pumped under 40 lbs. pressure through a 2 in. W. I. pipe, by a piston compressor a distance of 3 miles into stationary W. I. tanks, and distribution from these tanks controlled by governors, under low pressure.

APPENDIX "B."

DEPARTMENT OF ENGINEERING, SWARTHMORE COLLEGE. ENGINEERING LABORATORY. REPORT ON OXY-ACETYLENE WELDED PIPE JOINTS.

March 20, 1914.

The Philadelphia Suburban Gas & Electric Co.,
Chester, Pa.

GENTLEMEN:

The following is a report of the test made in the Experimental Laboratory of Swarthmore College on the 5 specimens of wrought iron and steel pipe submitted and tested March 13, 1914.

DESCRIPTION OF THE JOINTS.

The joints were made by welding two pieces of 1½ in. pipe together by means of the oxy-acetylene flame. This process also included the melting of a strip of metal around the joint, which materially increased the section of the pipe at that joint.

DESCRIPTION OF SPECIMENS.

Specimen No. 1, a plain welded butt joint of Byers' 1½ in. wrought iron pipe.

Specimen No. 2, a "V" welded butt joint of Byers' 1½ in. wrought iron pipe.

Specimen No. 3, a plain welded butt joint of Byers' 1½ in. steel pipe.

Specimen No. 4, a "V" welded butt joint of Byers' 1½ in. steel pipe.

Specimen No. 5, a sleeve joint, the sleeve being welded to the two ends of the pipe, See Fig. 16.

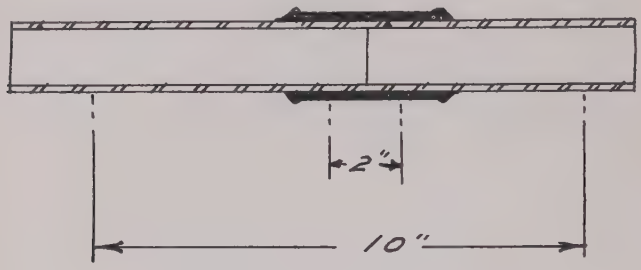


Fig. 16.—Details of specimen 5. Page 980, Appendix "B."

Method of Conducting Test.

Each specimen was tested in tension to destruction. The machine used in making the test is the standard Olsen 100,000 lb. tension testing machine. The method of holding the specimen in the machine is shown in Fig. 17. The iron core A inserted in each end of the pipe was a snug fit and enabled the jaws B to grip the pipe without crushing it or otherwise distorting the joint.

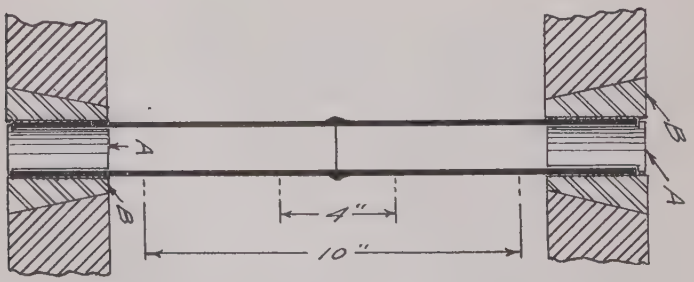


Fig. 17.—Method of holding test specimens. Page 980, Appendix "B."

Two test lengths were laid off on specimens Nos. 2, 3, 4 and 5: one length being 2 on each side of the center of weld while the other was 5 each side of weld. See Fig. 17.

In all tests the load was applied at a uniform rate of speed and readings were taken of the load and the resulting extension in both the 4 in. and 10 in. lengths. See data sheets.

Tests of Specimen No. 1.

This specimen was merely pulled to destruction without taking extension readings.

The maximum load obtained as shown by data sheet Fig. 18 was 39,750 lbs., or 49,500 lbs. per square inch of pipe cross

TEST No. 1.

Mechanical Laboratory—Swarthmore College.

Laboratory Test of WELDED JOINT (PLAIN) MYERS WROT IRON PIPE.
Kind of Test TENSION.
Material from
Machine used OLSEN 100,000 lb. Date 3-14 1914
Time of Testing min. Temp degrees F.

No.	LOAD. Actual. P	LOAD. Per sq. in. p	MICROMETER READINGS. Right I	MICROMETER READINGS. Left II	MICROMETER READINGS. Mean.	EXTENSION. Actual. λ	EXTENSION. Difference. Δλ	EXTENSION. Per in. ε	Modulus of Elasticity. E
1	39750	49500							
2									
3									
4									

Fig. 18.—Data sheet. Specimen 1. Page 981, Appendix "B."

section.

The break occurred in the pipe and above the weld. The weld showing no sign of failure.

Test of Specimen No. 2.

In this test extensions were read on both the 4 and 10 in-lengths for each load applied. The extension on each test length in inches per inch and the unit load in pounds per square inch of cross section of pipe was computed. See data sheet, Fig. 19.

Curves, Fig. 20, were then plotted between load in pounds per square inch and extension in inches per inch for both the 4 and 10 in. length.

It is interesting to note from the curve of this test—that the extension in inches per inch on the 4 in. length was little less than the unit extension on the 10 in. section over the

TEST NO 2.

Mechanical Laboratory—Swarthmore College.

Laboratory Test of "V" WELDED JOINT. BYERS' WROT IRON PIPE.
Kind of Test TENSION.
Material from
Machine used Date. 1
Time of Testing min. Temp degrees F.

No.	LOAD. Actual. P	LOAD. Per sq. in. p	MICROMETER READINGS. Right I	MICROMETER READINGS. Left II	MICROMETER READINGS. Mean.		EXTENSION. Actual. i	EXTENSION. Difference. JJ	EXTENSION. Per in. z		Modulus of Elasticity. E
1	500	625	4.	10.							
2	1200	1500	4.	10.	.00	.00			.00	.00	
3	2100	2625	4.	10.	.00	.00			.00	.00	
4	4000	5000	4.	10.	.00	.00			.00	.00	
5	9100	11370	4.	10.	.00	.00			.00	.00	
6	12000	15000	4.	10.02	.00	.02			.00	.002	
7	15000	18750	4.	10.03	.00	.03			.00	.003	
8	17000	21250	4.	10.04	.00	.04			.00	.004	
9	20000	25000	4.	10.05	.00	.05			.00	.005	
10	23000	28750	4.	10.07	.00	.09			.00	.009	
11	25000	31250	4.03	10.14	.03	.14			.007	.014	
12	27000	33750	4.07	10.25	.07	.25			.017	.025	
13	29000	36250	4.09	10.31	.09	.31			.022	.031	
14	32000	40000	4.15	10.45	.15	.45			.037	.045	
15	34000	42500	4.21	10.61	.21	.61			.052	.061	
16	38000	47500	4.38	11.10	.38	.110			.095	.110	
17	39900	48650	4.51	11.14	.51	.114			.127	.140	
18				11.40							
19											
20											

Original, Length { 4.0" / 10.0" } in., Diameter 1/2" in., Area sq. in.

Fig. 19.—Data sheet. Specimen 2. Page 981, Appendix "B."

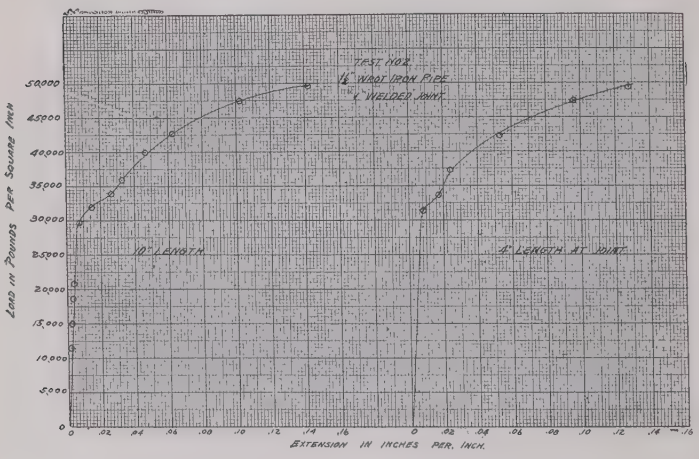


Fig. 20.—Curves from specimen 2. Page 981, Appendix "B."

whole pipe. On the 4 in. section the unit extension for the maximum load of 48,650 lbs. per square inch was 0.127 in. per inch and on the 10 in. section 0.140 in. per inch. That is the pipe seemed to stretch quite uniformly over its entire length.

The yielding strength from the curves is about 30,000 lbs. per square inch. The pipe failed about 4 in. above the weld, the weld showing no signs of failure.

Test of Specimen No. 3.

The data sheet, Fig. 21, and curves, Fig. 22, were computed

TEST No. 3.

Mechanical Laboratory—Swarthmore College.

Laboratory Test of WELDED JOINT PLAIN BUTT 1/2" STEEL PIPE.

Kind of Test TENSION

Material from

Machine used Date 1

Time of Testing min. Temp degrees F.

No.	LOAD. Actual. P	LOAD. Per sq. in. p	MICROMETER READINGS. Right I	MICROMETER READINGS. Left II	MICROMETER READINGS. Mean.		EXTENSION. Actual. λ	EXTENSION. Difference. Δλ	EXTENSION. Per in. ε		Modulus of Elasticity. E
1	5000	6250	4.	10.	.00	.00			.00	.00	
2	10000	12500	4.	10.01	.00	.01			.00	.001	
3	15000	18750	4.	10.01	.00	.01			.00	.001	
4	20000	25000	4.	10.02	.00	.02			.00	.002	
5	25000	31250	4.	10.02	.00	.02			.00	.002	
6	30000	37500	4.02	10.12	.02	.12			.005	.012	
7	33000	41250	4.07	10.24	.07	.24			.015	.024	
8	36000	45000	4.13	10.38	.13	.38			.032	.038	
9	40000	50000	4.21	10.64	.21	.64			.052	.064	
10	43370	54250	4.35	11.13	.35	1.13			.085	.110	
11	44000	55000	4.42	11.53	.42	1.53			.105	.153	
12	40500	50600	4.43	11.97	.43	1.97			.107	.197	
13											
14											
15											
16											
17											
18											
19											
20											

Original, Length 10" 4" in., Diameter 1/2" in., Area sq. in.

Fig. 21.—Data sheet. Specimen 3. Page 983, Appendix "B."

and plotted for specimen No. 3, in the same manner as for specimen No. 2.

Specimen No. 3, a plain welded steel pipe gave a unit extension in the 4 in. length of 0.105 in. per inch at the maximum load of 55,000 lbs. per square inch and an extension of 0.153 in.

per inch in the 10 in. section. From the curves the yielding strength of the steel pipe is about 27,000 lbs. per square inch.

This test shows that the steel pipe is stronger and more ductile than the wrought iron pipe.

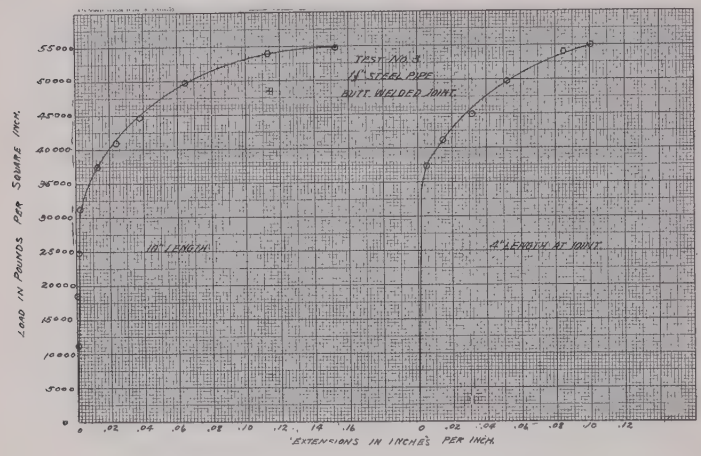


Fig. 22.—Curves from specimen 3. Page 983, Appendix "B."

The failure occurred about 3 in. below the weld, which showed no signs of failure.

Test of Specimen No. 4.

Specimen No. 4, a V welded steel pipe was marked and tested exactly as specimens Nos. 2 and 3 and the data sheet, Fig. 23, and curves, Fig. 24, computed.

The extension in this specimen in the 4 in. length at the maximum load of 54,900 lbs. per sq. in. is 0.132 in. per inch and in the 10 in. section it was 0.158 in. per inch.

The failure occurred in the joint in this specimen the fracture showing a crystalline structure.

Test of Specimen No. 5.

Specimen No. 5, a sleeve joint, the sleeve being welded to the steel pipe. Two test lengths were marked off, one 10 in.

TEST No. 4.

Mechanical Laboratory—Swarthmore College.

Laboratory Test of "V" WELDED JOINT. by 12" STEEL PIPE.

Kind of Test TENSILE.

Material from

Machine used. Date.

Time of Testing. min. Temp degrees F.

No.	LOAD. Actual. P	LOAD. Per sq. in. p	MICROMETER READINGS. Right l	MICROMETER READINGS. Left l1	MICROMETER READINGS. Mean.		EXTENSION. Actual. λ	EXTENSION. Difference. Jλ	EXTENSION. Per in. ε		Modulus of Elasticity. E
1	6000	7500	4.	10.					.000	.000	Drop shows beginning of true line
2	12000	15000	4.	10.	.00	.00			.000	.0045	
3	22000	27500	4.	10.036	.00	.068			.005	.010	
4	26000	31500	4.02	10.10	.02	.10			.015	.020	
5	30000	37500	4.06	10.20	.06	.20			.030	.036	
6	34000	42600	4.12	10.36	.12	.36			.050	.053	
7	38000	47600	4.20	10.53	.20	.53			.100	.122	
8	43000	53800	4.40	10.22	.40	1.22			.132	.158	
9	43800	54900	4.53	10.58	.53	1.58					
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

Original, Length { 10" / 4" } in., Diameter in., Area .799 sq. in.

Final " " " " " "

Fig. 23.—Data sheet. Specimen 4. Page 984, Appendix "B."

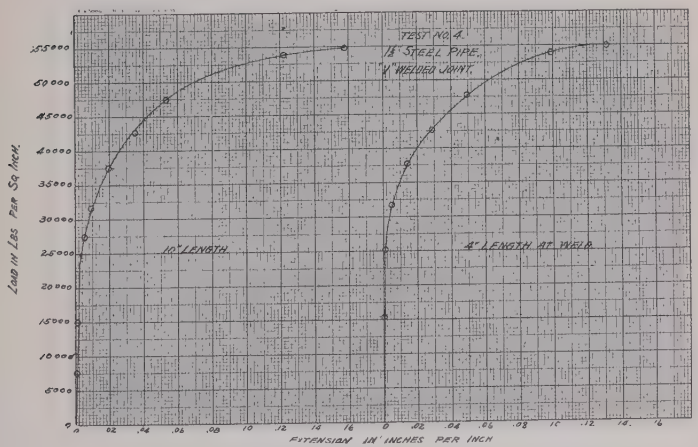


Fig. 24.—Curves from specimen 4. Page 984, Appendix "B."

length as in specimen No. 4 and one 2 in. section in the sleeve to determine the elongation of the sleeve.

TEST No. 5.

Mechanical Laboratory—Swarthmore College.

Laboratory Test of WELDED SLEEVE JOINT by 1½" STEEL PIPE.

Kind of Test TENSION.

Material from

Machine used Date

Time of Testing min. Temp degrees F.

No.	LOAD. Actual. P	LOAD. Per sq. in. p	MICROMETER READINGS. Right I	Left II	Mean.		EXTENSION. Actual. λ	Difference. dλ	Per in.		Modulus of Elasticity. E
1	6000	7500	2.	10.	.00	.00			.00	.00	
2	12,000	15000	2.	10.	.00	.00			.00	.00	
3	18000	22500	2.	10.	.00	.00			.00	.00	
4	24000	30000	2.	10.04	.00	.04			.00	.004	
5	28000	35000	2.	10.09	.00	.09			.00	.009	
6	32000	40000	2	10.18	.00	.18			.00	.018	
7	37000	46250	2.	10.36	.00	.36			.00	.036	
8	41000	51250	2.05	10.70	.05	.70			.025	.07	
9	42000	52500	2.07	11.03	.07	1.03			.035	.103	
10	38000	47500	2.07	11.37	.07	1.37			.035	.137	
11											
12											

Fig. 25.—Data sheet. Specimen 5. Page 986, Appendix "B."

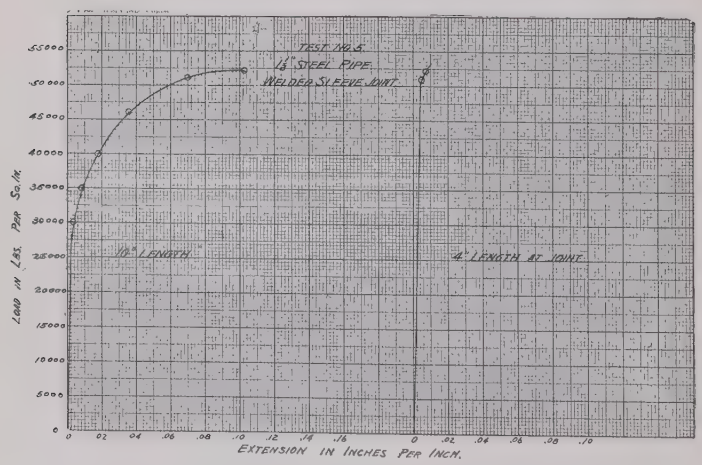


Fig. 26.—Curves from specimen 5. Page 986, Appendix "B."

The data sheets, Fig. 25, and curves, Fig. 26, were computed as in the preceding cases.

The extension in the 10 in. section at the maximum load of 52,500 lbs. per sq. in. was 0.137 in. per inch.

The extension in the sleeve was practically negligible. The failure occurred outside the sleeve joint, the sleeve joint showing no signs of failure.

Respectfully submitted,
(Signed) A. F. Blessing.

Specimen	Kind of pipe	Kind of weld. Joint	Yielding Strength of specimen. No. per sq. in.	Max. Strength of specimen. No. per sq. in.	Position of failure
No. 1	Wrought iron	Plain	—	49,500	Not in weld
No. 2	Wrought iron	"V"	30,000	48,650	Not in weld
No. 3	Steel	Plain	27,000	55,000	Not in weld
No. 4	Steel	"V"	27,000	54,900	In weld
No. 5	Steel	Sleeve	27,000	52,500	Not in sleeve joint

APPENDIX "C."

(Progressive Age, November 1, 1912.)

"But the compression of acetylene is another story. One of the dreams of the early acetylene industry was that this gas might be safely compressed into a liquid form for convenient transportation and storage. This would appear to be an ideal condition, as acetylene liquefies at the comparatively low pressure of 700 lbs. per square inch, and a cubic foot of liquid acetylene represents 400 cu. ft. of gas. This liquid is only four-tenths as heavy as water.

"It must be remembered that acetylene gas is an endothermic compound. In its formation heat is absorbed and that spontaneous decomposition will take place, liberating this heat if subjected to abnormal temperature or pressure.

"Many violent explosions have occurred due to liquefied acetylene, and now acetylene compressed in open containers

to a pressure exceeding 2 atmospheres (30 lbs.) is considered a very dangerous material.

"However, calcium carbide represents a more condensed form of acetylene for transportation than the liquefied gas. A cubic foot of carbide represents 500 cu. ft. of available gas, while a cubic foot of liquefied acetylene represents only 400 cu. ft. of gas.

"Recent developments have also provided a substitute for liquid acetylene in what is known as dissolved acetylene.

"While acetylene is soluble in its own volume of water, its very great solubility in acetone has broadened the field of the uses of acetylene many fold. Acetone will dissolve 24 times its volume of acetylene at atmospheric pressure and for each additional atmosphere to which it is subjected, a similar quantity will be dissolved; in other words, the solubility increases directly with the increase in pressure.

"Dissolved acetylene makes possible hundreds of uses of acetylene and the oxy-acetylene blow pipe, which would have been impossible before its discovery.

"With the use of dissolved acetylene and oxygen under pressure, a complete oxy-acetylene welding outfit is very readily portable and ready for instant use and can be used in many places where a generator would be impracticable or impossible. When acetylene is dissolved in acetone it seems to be devoid of all possibility of an endothermic explosion under pressure, but the bulk of acetone is greatly expanded by this great absorption of acetylene, and it will readily be seen that any container used for acetone for the dissolving of acetylene must be in capacity equal to the acetone expanded."

APPENDIX "D."

POINTS BROUGHT OUT IN BULLETIN NO. 45, UNIVERSITY OF ILLINOIS, "THE STRENGTH OF OXY-ACETYLENE WELDS IN STEEL.

Flame Regulations.—(*a*) Excess Acetylene Flame; (*b*) Normal Oxy-acetylene Flame; (*c*) Excess Oxygen Flame.

It was shown that the excess acetylene flame contained a

double cone. The short single cone excess oxygen. It was found that increase of 1 per cent. of the acetylene gas, would show a change in the appearance of the flame, provided of course, that this occurred at or near the normal flame regulation. It is also shown that the flame is more sensitive in indicating excess acetylene, than excess oxygen. The flame should be regulated altogether by cutting down the gas until the proper point is reached and the inner cone just disappears.

Manner of Computing Strength of Weld.—The stresses at the yield point and ultimate strength were computed by dividing the load from the graphical record, by the actual original area at the place where the rupture occurred, usually at the weld.

The efficiency of the weld was determined by dividing the ultimate unit stress (when rupture occurred at the weld) by the average ultimate unit-stress of the unwelded specimens, for the same sections of the plate, the efficiency being the ratio of the strength of the weld to the strength of the material.

Position of Plates Being Welded.—During the process of welding, the strips were sloped upward in the direction of welding, the greatest slope being 1 in. in 5. In working away from the operator, almost necessarily the blowpipe flame is directed toward the unwelded portion of the plate, making an angle of 60 deg. with the completed weld. The blast from the flame tends to force the melted metal from the end of the weld over upon colder metal, with which it does not unite and to make it difficult to build up the filling material to the required thickness.

If, instead the work progressed toward the operator, the blowpipe being held as described above, except that the blowpipe head makes an angle of about 120 deg. with the finished portion of the weld, the flame strikes the sloping surface of the molten metal at the end of the weld more nearly perpendicularly, and has less tendency to displace this metal.

Welds.—Some welds were made with plain ends, but a great majority were made with beveled edges. In the case of

the plain welds, no filling material was used, the weld depending upon the fusion of the two metals for its strength, the preference, however, seemed to be for the V shaped weld, as it was shown that a much higher strength could be obtained with a welder of average ability. Tests were also made to prove whether any advantages would be gained by the use of a gasoline torch to pre-heat the metal. By this pre-heating, the torch could be swung over a greater area of weld, and could be held at a greater distance, moreover, the filling flowed quickly into the weld. A rough estimate places the welding rate of pre-heated metals at about twice that of cold ones. However, no increase in the strength of the welds was shown. Another test made was to improve the strength of the weld by tapping the weld after being made, with a small hammer. This was done by welding for about ¼ in., then tapping about fifteen times with the hammer, with a 2 in. stroke. This method, however, did not show any increase in strength of weld. Further experiments were made in an attempt to strengthen the weld by forging same. This method showed an increase in the strength of the weld of 10 per cent. in efficiency. The general conclusion was that an ordinary skilful welder should be able to make welds of about 86 per cent. efficiency. In order to obtain this efficiency, however, it will be necessary to thoroughly fuse the metals.

Effect of Bad Regulation.—The decrease in efficiency due to excess oxygen was shown to be only 1.9 per cent., and for the acetylene flame 3.5 per cent., therefore showing that there was no excuse for greater variation in commercial work due to improper regulation.

Rate of Welding.—It was shown a rate of welding of from 2 to 3 ft. could be maintained by a workman of average skill. The welding rate is nearly constant at 17.5 sq. in. of weld section per hour. The cost of welding beveled plates is about 25 cents per cubic inch of filler, assuming oxygen at 3 cents per cubic foot, and acetylene at 1 cent per cubic foot and labor at 30 cents per hour.

Rate of Consumption of Gas and Oxygen.—The proportion of acetylene for all sizes of blowpipes at normal regulation averages 42 per cent. in the tests. This is a ratio of 1.38 volumes of oxygen to 1 of acetylene, which is much less than the ratio of 1.7 usually given. It was also noted that one manufacturer states that the rate of 1.28 to 1 has been "adopted." This is nearly the ratio fixed by the Academy of Science, France, which selected a ratio of 1.30 to 1. The latter two values are nearer to these found by the tests than that given by the manufacturer, and may be more nearly correct.

Gas Consumption.—The general conclusion was shown to be about 3 cu. ft. per hour for a No. 3 blowpipe, to about 14 cu. ft. for a No. 8 blowpipe.

The consumption for a properly adjusted flame was shown to be for a No. 3 blowpipe 3 cu. ft.; No. 4 blowpipe, 3½ cu. ft.; No. 5 blowpipe, 5½ cu. ft.; No. 6 blowpipe, 9 cu. ft.; No. 7 blowpipe, 13 cu. ft.; No. 8 blowpipe, 14 cu. ft. per hour respectively.

Oxygen Consumption.—Due to the low pressure acetylene (about 0.4 lbs. per sq. in.) and the high oxygen pressure (about 12 lbs. per sq. in.) for blowpipe No. 5, it was shown that the oxygen rate remained constant or nearly so. If any change did occur, it would be a decrease in the oxygen rate as the acetylene rate increased. The averages of the oxygen rates for blowpipe No. 5 follows: Both cocks full open, 7.83; double cone regulation, 7.48; normal regulation, 7.69; short cone regulation 7.53; average 7.63 cu. ft. per hour. This led to the conclusion that the oxygen rate is practically constant for any given blowpipe and oxygen pressure.

Apparatus Used.—In these tests the Fouché blowpipe was used, which consisted of a blowpipe, hydraulic back pressure valve, tank of compressed oxygen, oxygen pressure regulator, blue glasses and rubber hose. This is the low pressure torch. Fouché invented his blowpipe probably about 1902 or 1903, but the process was not introduced into this country until 1904, when the Fall River Shipbuilding Company of Quincy, Mass.,

installed an oxy-acetylene blowpipe for welding sheets of metal which had been formerly riveted.

APPENDIX "E."

SPECIFICATIONS FOR HIGH PRESSURE INSTALLATIONS.

Compression Station.

Station.—The compressor station to consist of two steam driven, direct connected compressors, duplicate boilers, recording pressure gauge and steam gauge.

Compressors.—The capacity of the compressors to be such that either could alone supply the maximum demand for the peak demand of the year. To be vertical, single, duplex or compound as convenience or requirements may demand.

Boilers.—The boiler capacity to be of sufficient horse-power so that the steam pressure could be maintained at all times by either of the boilers singly.

Steam Connections.—A welded steam main, connected by separate connections to each boiler, to be run in such a way that the compressor may be connected to it as to a manifold. All outlet connections from this line to be welded and connected to compressors to be made with a long bend of at least 3 ft. radius. No fittings to be used in these connections. Extra heavy flanged unions with 1/32 in. sheet lead gaskets to be used in making connection. Flanged unions to be welded to the pipe or the Van Stone type of joint used.

Auxiliary Steam Line.—An auxiliary steam main, connected by separate connections to each boiler, to be provided and to which the compressors are to be connected separately. This line to be held in reserve for such times when, for some cause, it is necessary to shut off the main steam line.

Connection to Storage Holder.—The connections to the compressors to be made by separate outlet from storage holder. This connection to be made in the shape of "U" and made of extra heavy wrought iron pipe. If building new holder, provide an extra outlet for inlet to compressors.

Inlet Connections to Compressor.—The inlet connections

never to be less and, preferably, one size larger, than the suction inlets to compressor.

Discharge Connections.—The discharge connections never to be less and, preferably, one size larger, than the discharge openings from the compressors. The connections to be full weight wrought iron or steel pipe. All joints and connections to be welded, except those which are to connect valves or connection to compressor, which are to be made with extra heavy flanged unions with 1/32 in. sheet lead gasket.

Inlet and Outlet Valves.—The inlet and outlet connections to be provided with gate valves and to be so arranged that either compressor may be operated singly.

Manifold and Manifold Valve.—The compressors to be connected to a manifold which connects the pulsation tank, hereafter specified, and in this manifold, placed beyond the by-pass and safety valves, hereafter specified, a combination globe stop and check valve.

By-pass and Safety Valves.—The discharge pipes from the compressors to be provided with by-pass and ball and lever safety valves. The by-pass to be connected from the compressor manifold, in advance of the globe stop and check valve, to the inlet gas main of compressors, so that any excess pressure may be relieved by passing gas back to the main.

Gas Governor.—A gas governor should be connected to the high pressure side of the compressor and the throttle valves of the compressors to control the maximum pressure desired on the line.

Pulsation Tank.—Immediately following the compressor placed on the outside of the building a combination pulsation tank, condenser and expansion tank to be placed vertically above ground. The lower portion of this tank, which will be the expansion portion of the tank, to be provided with try cocks at different heights of the tank in order that the depth of the condensation in the tank can be proven, a suitable depth of which should be left in the tank in order that it may act as an auto enricher.

Provision also to be made for blow-off pipe to be connected at the bottom of the tank in order that any excess accumulation of condensate may be removed. The inlet connection to the tank, if it cannot be made with a straight connection, to be made with a bend with as large a radius as the position of the tank will allow.

The outlet connection to be taken from the upper portion of the expansion section, and like the inlet connection, to be made preferably straight; if, however, this cannot be done, then to be made with a bend with as large a radius as possible. This connection to be connected to the gas main by extra heavy flanged union with 1/32 in. sheet lead gaskets.

Pressure Gauges.—A high pressure recording pressure gauge and steam pressure gauge connected to high pressure main to be set up in compressor house. To be brought together on one board and at a convenient place for observation. The steam gauge also to be fitted with electric contacts, to be set at low and high points of pressure in order to give warning to man in charge.

Valves.—All valves used in connecting compressors to be extra heavy cast iron.

Laying Mains.

Pipe Specifications.—The pipe shall be lap-welded, made of Bessemer or open hearth steel of the best welding quality, free from blisters, cracks or other injurious defects, or guaranteed full weight W. I.

Inspection.—Each length of pipe to be inspected for defects inside and outside. A flattening test to be made on each crop end with the weld near the side, crushing the end down to one-quarter the diameter of the pipe. It must not show cracks in the material or opening at the weld.

An internal hydrostatic test is to be made on each length of finished pipe, using the pressure customary in regular mill practice.

Stringing Pipe.—The pipe to be strung along the road out of gutters, and on opposite side of road from trench.

Coating Pipe.—The pipe to be coated in the following manner: First, see that the pipe is thoroughly clean and free from rust, and also remove any burrs or projections of metal. Put the coating in a trough with steam coil in the bottom. Run steam through the pipe from 10 to 30 seconds until the pipe is thoroughly heated and dry, after which place a plug in the ends of the pipe to prevent coating from getting into the inside of the pipe. The pipe to then be dipped into the coating and allowed to remain in long enough to completely coat the pipe, after which it is taken out and wrapped with muslin or manila paper torn or cut into 5 in. strips.

After being wrapped the pipe is again dipped; the excess coating to be removed by revolving the pipe in contact with a wooden paddle.

If it is necessary to coat the pipe in the field, the pipe to be coated as follows: Thoroughly scour pipe with a suitable wire brush in order to remove all rust and scale, and also see that all burrs or projections of metal are removed. Put the coating material in a pail, under which a fire box is provided in order to keep the coating in a fluid state. The coating to be applied with a 4 in. or 5 in. flat brush and to be applied in advance of the pipe laying or may be applied as the pipe is laid, but always in advance of the pipe being placed in the ditch.

The pipe to be thoroughly inspected before being covered, for any abrasions to the coating that may have occurred in transportation or in handling. All abrasions to be thoroughly recoated.

Cleaning Out Pipe.—The pipe to be thoroughly cleaned on the inside of any dirt and of any loose scale, by running through the pipe a cleaner of sufficient length to extend the full length of the longest length of pipe from end to end.

Pipe Inspection.—The pipe before being welded to be thoroughly inspected for any defective lengths and to see that the

pipe has been thoroughly cleaned on the inside of any dirt that may have gotten there in transportation.

Joints.—The joints to be oxy-acetylene butt welded throughout, except those that may be hereafter otherwise specified.

Welding Pipe.—In welding the pipe the ends to be welded together and to be brought to a perfect alignment by an assistant to the welder. This assistant to be a person who is capable of doing this work quickly and in an intelligent manner. The welder to thoroughly weld the pipe through the wall of the pipe and to build the weld up slightly above the metal of the pipe. The finished joint to be from 90 to 100 per cent. of the tensile strength of the pipe itself.

Trench.—The trench to be of sufficient depth to insure a covering for the pipe of 2 ft. 6 in. and the trench to be dug to a proper depth and graded before lowering the pipe. The bottom of the ditch to be graded so that the pipe will lay on the bottom of the trench without any unnecessary leveling with blocks, and so that the pipe will drain to all low points.

No change in the cover as here specified to be permitted only by the consent of the engineer in charge.

Lagging Pipe.—At any place where the pipe is exposed, such as bridge crossings, the pipe to be lagged with an asbestos pipe covering protected with a suitable weather-proof covering.

Fitting Valves.—Steel valves to be fitted into the line with extra heavy steel flanges and in order that this may be done with no screw joints, lengths of pipe to be made up with a welded flange on one end. The flange joints to be made with 1/32 in. lead gaskets.

The valves to be provided with a small equalizing by-pass connection and blow-off pipe from the under side of valve, as shown in Fig. 27.

Locating Valves.—Valves to be placed every ½ mile or as near to this distance apart as possible; however, when a good land mark can be found either a little less or a little more than the above distance, in relation to which the valve could be

located, it would be better to thus place the valve in order to more easily find it when wanted.

It may also be necessary to so place valves in relation to points where it is expected to run lateral lines from the trunk line, without any reference to the ½ mile as specified above; in such cases judgment and care should be exercised.

Locating Drips.—At all low points in the line a drip should be placed, this to be as carefully attended to as in a low pressure line.

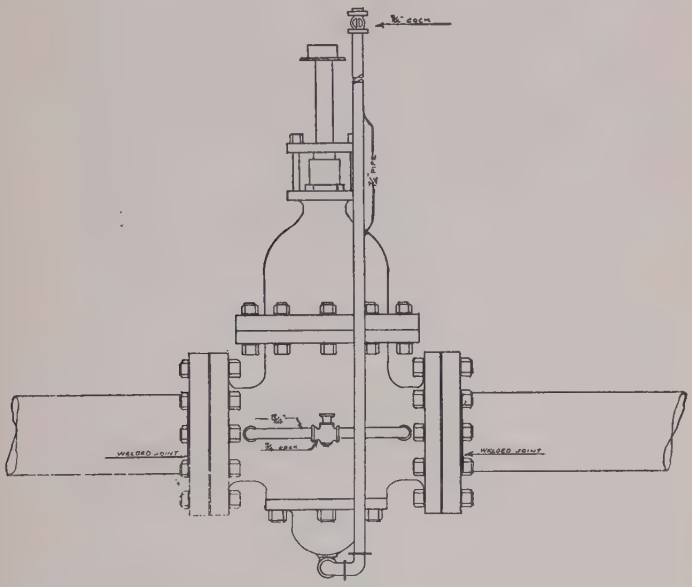
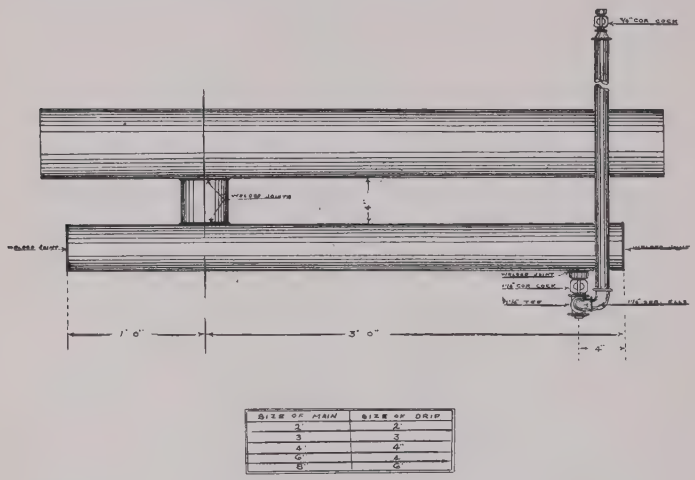


Fig. 27.—High pressure valve showing by-pass and blow-off pipe.
Page 996, Appendix "E."

Style of Drip.—The drip to be made throughout with welded joints except where those joints are made in connecting the riser to the main body of the drip. The drip may be made by either of the styles shown on Fig. 28 or 29. If the point at which the drip must be located is hard rock, the style No. 2 drip to be used in order to avoid unnecessary expense; if, however, the digging is good, the style No. 1 drip to be used.

Turning from One Road to Another.—Where a line turns from one road to another, and it is contemplated extending over the first road at some future time, the turn to be made by welding into the line at this point at a suitable angle for the proposed main, a full sized branch piece from which the future main can be extended and to the end of this outlet thus formed, a suitable flange to be welded and closed by a blank flange thus providing for future valve connection.



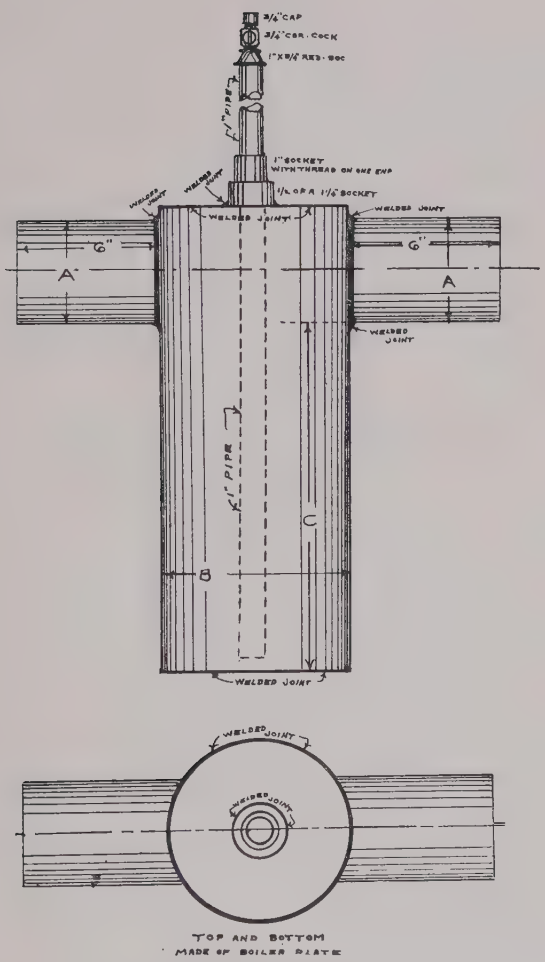
SIZE OF MAIN	SIZE OF DRIP
2"	2"
3"	3"
4"	4"
6"	4"
8"	6"

Fig. 28—Welded drip. Style 1. Page 997, Appendix "E."

At other turns a pipe bend of a radius of at least 6 ft. to be made, the bends to be made cold on the job. Up to and including 4 in. may be made with man power, above this size with hydraulic jacks.

Branch Connections.—No fittings such as those commonly known as malleable or steel screw fittings to be used. In place of these fittings, however, at any street intersections where it may be desired to extend a gas main in the future, a branch piece of suitable size with welded flange on the end to be welded to the main. The main not to be tapped until main is extended from the connection thus provided.

Grade.—The pipe to be laid to grade, this to be attended to



A	B	C
2"	6"	8"
3"	8"	12"
4"	8"	15"
6"	10"	16"
8"	12"	16"

Fig. 29.—Welded drip. Style 2. Page 997, Appendix "E."

with as great care as is done in laying a low pressure line. The line to be leveled where necessary with blocks of wood; no stones to be permitted for the purpose.

Expansion.—No expansion joints to be used. The contraction of the pipe that may take place to be provided for by the pipe itself not being placed in a perfectly straight line in the ditch. To take care of contraction near valves, the companion flanges for the valves should be bolted together without the valve until line is laid, then separated to insert valve by lifting on the pipe. Insert the valve and crowd pipe back into trench.

Sharp Angle Turns.—If at any point in the road, over which a main is being extended, there should be a sharp angle, or any turn in the road which would require springing the pipe to get it in the ditch, at such points the pipe to be bent to conform to the angle of the road so that it will lay in the ditch without any springing whatever.

Testing.—The line to be tested with an air pressure considerably in excess of the pressure to be carried. When the line is designed to carry a pressure from 30 to 40 lbs. it should then be tested with 50 to 60 lbs. air and while pressure is on test over all joints with soap suds for leaks. If any leaks are found such joints to be repaired by again welding over the leaking portion and again testing as before to insure an absolutely tight main.

Roadway Boxes.—All valves and drips to be provided with roadway boxes.

Back Filling.—The ditch to be thoroughly tamped, when backfilling, and to be finished in such a manner that no accidents will result from soft ditches.

If the ditch has extended through rock, no rock thus excavated to be backfilled around the pipe. The pipe to be covered with a good covering of dirt before any rock is placed in the ditch.

Lateral Main Connections.—The connection for a lateral main to be made by connecting to the connection, provided in the trunk line, a steel valve of the size of the main being ex-

tended. Through this valve, tap the main, from which the lateral is being taken, with a high pressure tapping machine using a drill of diameter sufficient to give delivery required. If, however, no connection has been provided for such lateral main connections, then a suitable valve connection with welded flange to be welded to the main line, after which proceed as above specified. See Fig. 30.

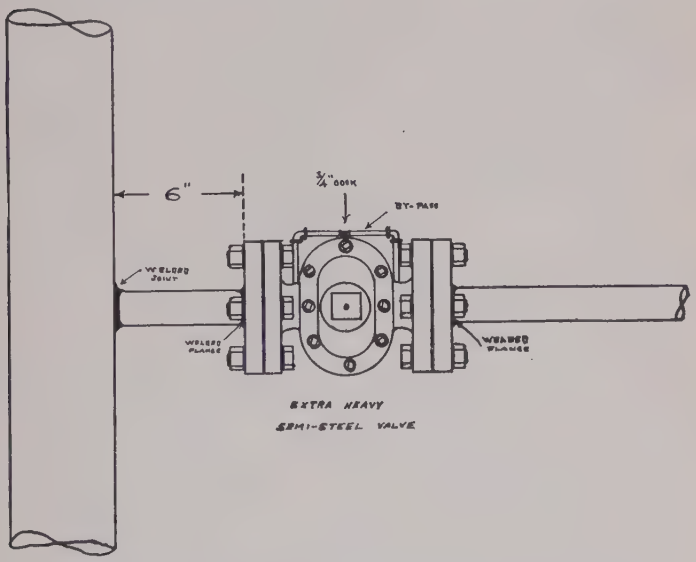


Fig. 30.—Welded lateral main connection for sizes from 1½" up.
Page 1001, Appendix "E."

Valve and Drip Markers.—All valves and drips to be marked, when it is impossible to locate in relation to a permanent and good land mark, by a marker set at the side of the roadway. The marker to be made of 4 in. pipe about 2 ft. 6 in. long and set in concrete and filled inside of pipe to about 1½ in. of top with concrete, filling the remaining 1½ in. with a mixture of cement and sand, and into which tacks or small nails are set in outline of the distance from marker to valve or drip.

The pipe used for marker need not be good pipe, as any pipe that will not be of any use for mains can be used. For details of marker see Fig. 31.

Main Material.

Pipe.—The pipe to be standard plain end steel pipe. The ends of the pipe to be chamfered to 30 deg. and to be finished

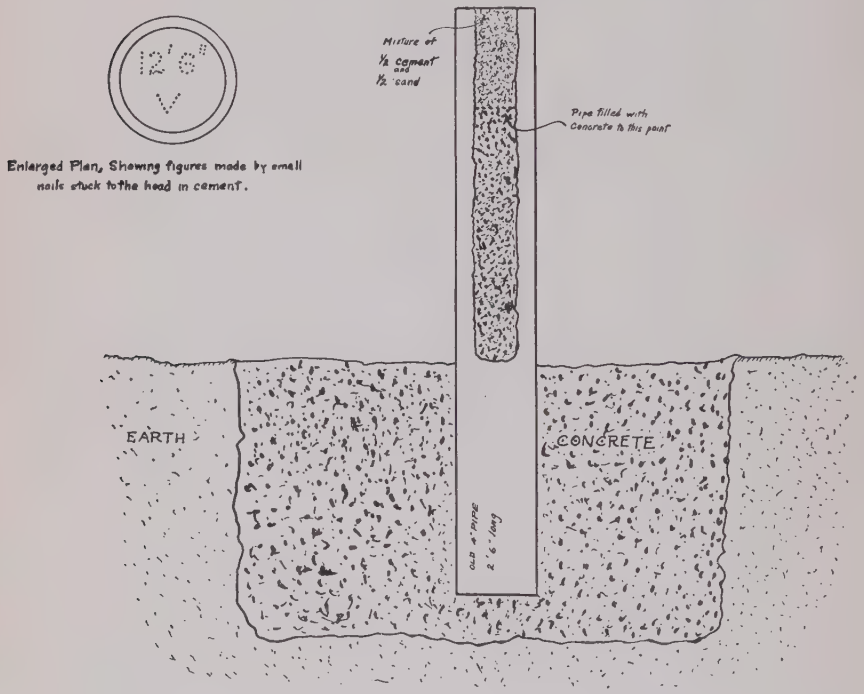


Fig. 31.—Valve and drip marker. Page 1002, Appendix "E."

smooth with no burrs or ragged edges such as are usually made with pipe cutters.

The weight of the pipe to be standard weights, 1½ in. to weigh 2.717 lbs., 2 in. to weigh 3.652 lbs., 3 in. to weigh 7.575 lbs., 4 in. to weigh 10.79 lbs., 6 in. to weigh 18.974 lbs., and 8 in. to weigh 28.554 lbs. per lineal foot respectively. Pipe

weighing 5 per cent. less than these standard weights not to be received.

The lengths of pipe to be random lengths 35 ft. to 40 ft. long.

Valves up to 4 in.—All valves to be extra heavy flanged Ferro steel, bronze spindle, gate valves, specially designed for high pressure gas and are to be specified as follows:

Extra heavy Ferro steel, bronze spindle, clean-out pocket flange gate valve with wedged gate. The flanges between the body of the valve and the bonnet to be made up with lead gaskets, also the body of the valve and the clean-out pocket to be put together with lead gasket. The clean-out pocket to be tapped for a ¾ in. pipe connection. The stuffing box to be twice the usual depth of the standard stuffing box. Open to the left with non rising stem.

Valves above 4 in.—All valves above 4 in. to be specified as those from 4 in. down, except that they be extra heavy steel.

Roadway Boxes.—The roadway boxes for the drips to be round and to be 8 in. in diameter; the body of the box to be made in one piece with large flanged bottom.

The roadway box for the valves to be a round extension box with plug cover.

Pipe Coating.—The most practical coating to be used is a clean coal tar pitch, free from water, acids or soluble mineral matter. Such a pitch should be as hard as it is possible to make it without having a decided brittleness at ordinary temperatures.

The pitch should not crack when struck a hard blow.

Laying Service.

Size.—The size of service to be ¾ in.

Connection for Services below 30 lbs. Pressure.—The connection to be made by taking an ordinary ¾ in. socket cut into two halves, welding the plain end of one-half thus obtained to the main. The main to be tapped ⅜ in. through a ¾ in. corporation cock, which is screwed into the socket above men-

tioned. Screw on to the cock a ¾ in. galvanized tee and into the side outlet of this tee screw a ¾ in. galvanized service ell from which extend the service.

When service is designed to carry pressures above 30 lbs. the connection to be made as follows: Weld to the main a ¾ in. steel body corporation cock, or preferably, if obtainable, a ¾ in. steel body gate valve. These cocks or valves to be provided with plain ends for welding. Through this cock or valve tap the main as specified above, extending the pipe by welding to the cock or valve, using no other fittings.

Joints.—The only screw joints to be those of the swing joint at the main and the curb and lock cocks. All other joints to be welded. When service is designed for pressures above 30 lbs. the joints to be welded throughout.

Dope for Screw Joints.—The thread dope to be made of either one of the following mixtures: First, ⅓ raw linseed oil and ⅔ Portland cement; second, equal parts of red and white lead mixed with linseed oil.

Fall of Pipe.—The service to be laid with a grade of at least 1 in. to 10 ft. and to be laid without any sags in the pipe. The ditch to be carefully bottomed up, or if necessary, the pipe to be leveled with blocking. No stones to be permitted for leveling.

Blow-off.—The service gang to extend a ¾ in. blow-off pipe from the inside of cellar wall to the outside atmosphere. The outlet of this pipe never to be placed under porch, or left at any place where the gas could not escape at once to the outer air. The fall of this pipe to be to the cellar.

Painting Threads.—In making screw joints the thread dope to be painted on the male thread only.

Curb Cock and Box.—At the curb a ¾ in. curb cock with a standard extension curb box to be used. The key of the cock to be solid with a full way tapped opening.

For services designed to carry pressures above 30 lbs., a special steel body cock, or preferably if obtainable, a steel

body gate valve with suitable ends for welding. This valve to be protected as much as possible from moisture and dirt.

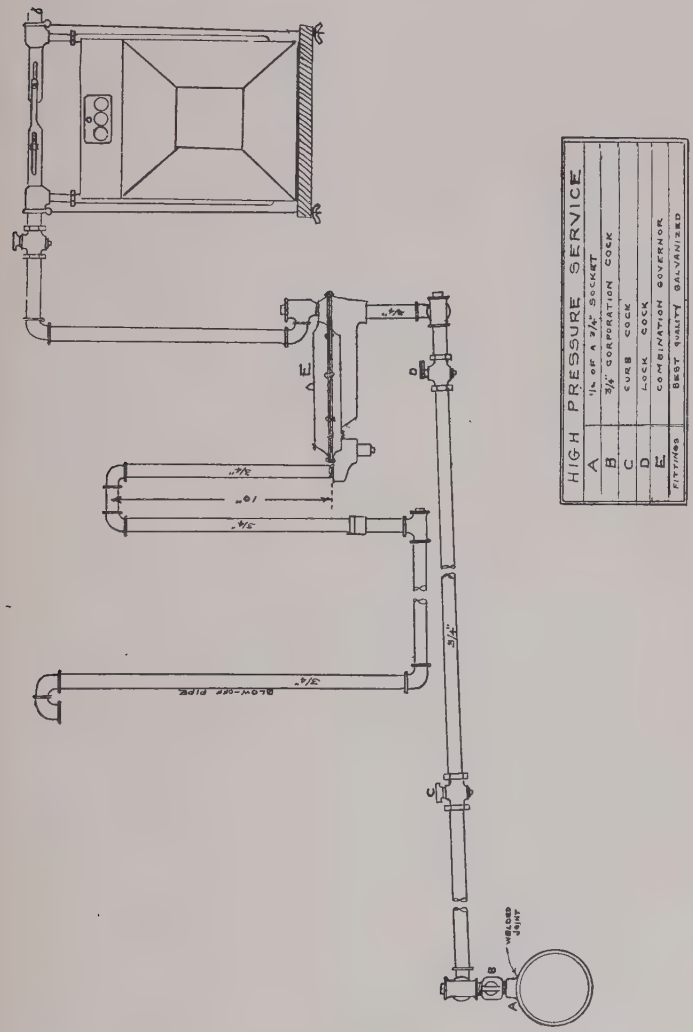


Fig. 32.—Service cover and meter connections. Page 1006, Appendix "F."

Lock Cock.—At the end of the service, inside of the cellar

wall, a ¾ in. lock cock to be used. The key of the cock to be solid with a 3/16 in. drilled hole at the bottom of the body opening.

Governor.—The governor to be No. 1 or No. 2 combination governor and seal; the size to be governed by the estimated demand. The governor to be sealed with mercury of just sufficient quantity to insure its blowing at a pressure of about 6 in. of water column.

Fittings.—All fittings used in connecting up governor to be the best malleable galvanized.

Connection to Blow-off Pipe.—From an outlet on the governor placed there for the purpose, a connection to be made with ¾ in. pipe to the blow-off pipe. This connection to rise from the outlet thus provided on the governor 10 in. or 12 in. before turning down to be connected. The blow-off pipe when the combination governor is used, by reason of its being directly connected to the governor, is also the vent pipe of the governor.

Service Protector.—The service pipe through the cellar wall, to be protected by reinforcing with a piece of 1¼ in. pipe through which the ¾ in. pipe is run, the annular space between the two pipes to be filled with pitch. Lengths of ¾ in. pipe to be made up in quantities with the protectors and kept in stock ready for use. The protector is a precautionary measure against the possibility of the service pipe rusting out inside the cellar wall, thus allowing the gas to escape into the house. See Fig. 3.

Coating.—For specification for method of coating see specification for coating main.

Sketches.—For full detail of service, governor and meter connections see Fig. 32.

Service Material.

Pipe.—The pipe to be standard ¾ in. steel pipe to weigh 1.13 lbs. per foot. The plain end pipe to be finished with a straight even edge.

Curb Cock.—The curb cock to be the best quality obtainable. To be made of brass and drilled with a full way opening.

Lock Cock.—The lock cock to be the best quality obtainable, and to be drilled 3/16 in. at the bottom of the body opening.

Corporation Cock.—The corporation cock to be the best quality obtainable. To be made of brass and to be tapped with a ½ in. opening.

Plain End Corporation Cock.—The plain end corporation cock to be made with extra heavy steel body and with bronze plug. The ends to be made from 2 in. to 3 in. long.

Valves.—The gate valve to be extra heavy steel bronze mounted and to be made with plain ends. To open to the left, and on the stem instead of the usual square head, a head to be provided that will allow an ordinary curb key to be used for closing and opening.

Coating.—The coating use on service pipe to be the same coating specified in main material.

Curb-Box.—The curb-box to be an extension box of the standard pattern, the same as used for low pressure service.

District Regulators.

When a high pressure line is used as a means to transmit gas to a distant district where the gas is distributed under low pressure, it is necessary to install a regulator or regulators in order to govern the pressure to that desired in the low pressure district; in which case the following specifications will be applicable according to the nature of the district served.

District Served From One Source.—When a low pressure district is served from one source, a "Double District Regulator" to be installed, being connected between the high pressure and low pressure mains. This regulator to be capable of lowering the pressure from the 30 pounds or more carried in the high pressure mains to the desired pressure in inches of water in the low pressure mains. A double district regulator is provided with two main regulators, each of which is provided with valves at inlet and outlet. There is also provided

two secondary regulators for each main regulator; these secondary regulators controlling the opening and closing of the main regulators, thus insuring a constant and even pressure at the outlet at all times, no matter what the demand might be.

One regulator of a double district regulator should be shut off, it being held in reserve to be used in case the one in action should get out of order and need to be shut off in order to make repairs, thus insuring against any possibility of the gas supply being shut off.

District Served From Two or More Sources.—When a district is served from two or more sources a single district regulator to be used at each point from which the gas supply comes. These regulators are the same as the double district regulators, the difference in these regulators being, as their name implies, one a single regulator connected between the low and high pressure mains; while the other is a regulator composed of two regulators brought together on the one inlet and outlet pipe, all the essential features of each being the same.

The necessity for a double district regulator does not exist when a district is served from two or more sources, as there is no danger of the gas supply being shut off by one regulator getting out of order.

Low Pressure Boosted From High Pressure.—When a low pressure district has its gas supply boosted from a high pressure line, the single district regulator to be installed. The regulator being installed to be the one specified for a district served from two or more sources.

Pressure Gauges.—A high pressure recording pressure gauge to be attached to the high pressure side of the regulator, and a low pressure recording pressure gauge to be attached to the low pressure side of the regulator. The recording gauges to be brought together on one board and to be set up in a perfectly vertical position; in addition to these, provision to be made on the pipe to the low pressure gauge for a "U" gauge in order that the accuracy of the former may be tested from time to time.

Safety Seal and Blow-off.—A blow-off pipe with a safety seal to be carried to the outside atmosphere. The blow-off pipe to be 1½ in., 2 in. or 3 in. to be determined by the size of the high pressure main and the distance necessary to run to reach the outside air. When the run is not over 15 ft., 1½ in. to be used for a 2 in. main and 2 in. for a 3 in or 4 in. main;

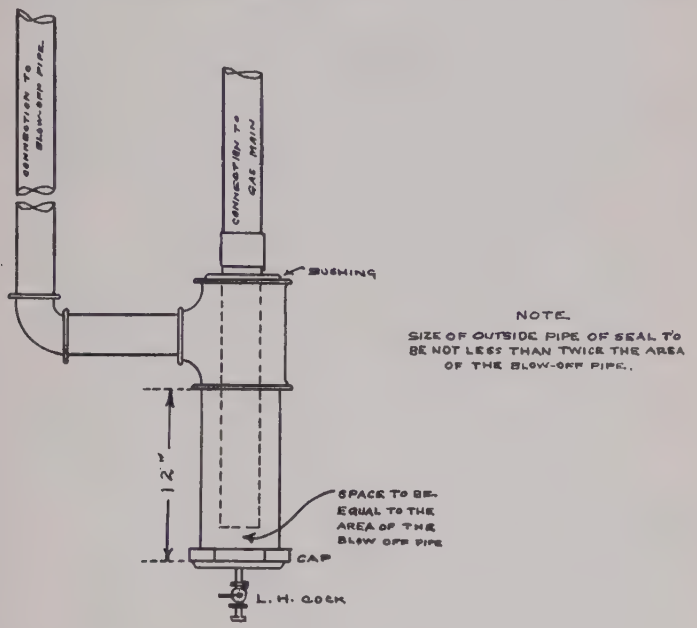


Fig. 33.—Mercury seal for district governor. Page 1009, Appendix "E."

when run is in excess of this, 2 in. to be used for a 2 in. main and 3 in. to be used for a 3 in. main.

The safety seal to be a mercury seal with just sufficient mercury to carry a pressure a little in excess of that desired in the low pressure system. Mercury should be pure and free from lead. Specific gravity 13.58 to 13.59. For details of seal see Fig. 33.

Housing.—The regulator to be preferably placed in a manhole in the roadway. This manhole to be constructed of rein-

forced concrete and made water tight in every respect. A drain to be run, if possible, from floor of manhole pit to sewer. The manhole with suitable hinges, and the cover to be provided with a balance weight to assist in opening. If conditions should not permit the regulator being installed in manholes, then a house of a suitable size to be built at the side of the roadway in which to install the regulator.

Locating.—The regulator to be located at a point in the road or street to insure a proper drainage of water from the manhole at all times; this to be very carefully attended to even though a sewer connection can be secured to carry the water off, as it is very important to have the regulator in as dry a place as it is possible to secure.

APPENDIX "F."

SUMMARY OF TEST SHOWING LOSS IN ILLUMINATING AND HEATING VALUES DUE TO COMPRESSION OF APPROXIMATELY 30 AND 40 POUNDS PER SQUARE INCH AND TO TRANSMISSION OF ABOUT 9 MILES— ENRICHED COKE OVEN GAS.

Amount compression (initial) lbs.	30.5	40.0	30.5	40.0
	Illuminating		Heating	
	Value	C-p.	Value	B. t. u.
LOSS DUE TO COMPRESSION.				
Uncompressed gas at (station)	16.2	16.9	598	597
Compressed gas at (station)	14.4	14.2	578	579
Loss—				
Actual	1.8	2.7	20	18
Per cent. of uncompressed	11.1	16.0	3.34	3.02
LOSS DUE TO TRANSMISSION.				
Compressed gas at (station)	14.4	14.2	578	579
Compressed gas at delivery point	10.4	0.1	557	556
Loss—				
Actual	4.0	5.1	21	23
Per cent. of uncompressed	24.7	30.2	3.51	3.85
TOTAL LOSS DUE TO COMPRESSION AND TRANSMISSION.				
Uncompressed gas at station	16.2	16.9	598	597
Compressed gas at delivery point	10.4	9.1	557	556
Loss—				
Actual	5.8	7.8	41	41
Per cent. of uncompressed	35.8	46.2	6.85	6.87

January 30, 1913.

LOSS IN ILLUMINATING AND HEATING VALUES OF ENRICHED COKE OVEN GAS DUE TO TRANSMISSION OF COMPRESSED GAS THROUGH A DISTANCE OF ABOUT 9 MILES.

Summary.

Coke Oven Gas Enriched with 80 Per Cent. Benzol.

Amount of compression at station	30.5	30.2	30.5	30.2
	Illuminating		Heating	
	Value	C-p.	Value	B. t. u.
Test	(1)	(2)	(1)	(2)
Compressed gas at station	14.4	16.4	578	594
Compressed gas at delivery point	10.4	10.4	557	562
Loss due to transmission				
Actual	4.0	6.0	21	32
Per cent. of compressed at station	27.7	36.6	3.6	5.4

Coke Oven Gas Enriched with 80 Per Cent. Benzol and the Addition of About 15 Per Cent. Carbureted Water Gas.

Amount of compression at station	31.7	40.0	31.7	40.0
	Illuminating		Heating	
	Value	C-p.	Value	B. t. u.
Test	(3)	(4)	(3)	(4)
Compressed gas at station	17.2	14.2	610	579
Compressed gas at delivery point	11.3	9.1	579	556
Loss due to transmission				
Actual	5.9	5.1	31	23
Per cent. of compressed at station	34.3	35.9	5.1	4.0

January 14, 1913.

(Mr. Shattuck read an abstract of his paper.)

The Chairman: Gentlemen, you have heard Mr. Shattuck's abstract, and I hope that there will be a very good discussion on it. This business of welding pipe is new.

Mr. Walton Forstall (Philadelphia): The general impression derived from reading Mr. Shattuck's paper is that the distribution engineer whose conditions up to date have not called for any extensive investment in high pressure mains, is fortunate, because in this high pressure work, as in all other new departures from established practice, the beginner has to blaze the way, and he is bound to make a certain number of mistakes. When high pressure distribution was first suggested,

the idea was too enthusiastically taken up in certain quarters, and installations were made on the strength of cost comparisons which gave high pressure the benefit of the decreased first cost and omitted items of increased maintenance, since shown by experience and now emphasized by Mr. Shattuck. His six conditions under which high pressure may or may not be employed, deserve the careful attention of every one considering such installations.

The leakage figures given on page 951 for non-welded lines, if unchallenged, will remain as an indictment against the screwed line, but it seems hardly possible that, after Mr. Rice's paper of last year advocating a screwed line, or at least not mentioning any serious defects in such a line, Mr. Shattuck's data should be typical of many installations.

This is certainly a splendid opportunity for the high pressure engineers to compare experiences, to the end that their practice be standardized. It would seem that a properly constituted committee, starting with the Rice and Shattuck papers and their accompanying discussions, could not fail, within a year's time, to put before those interested in high pressure work, much information not now readily available.

If Mr. Shattuck has in his possession costs of previously laid screwed lines, it would add to his paper if he would furnish us with some comparisons between screwed and welded lines, similar to the comparison for 8-inch lines that he quotes from Mr. L. B. Jones.

Mr. H. W. Terry, Jr. (Ossining, N. Y.): On page 951, Mr. Shattuck mentions a test made for leakage between the hours of 1 and 4 A. M. At our works all the gas sent out in the high pressure system passes through a wet drum station meter before reaching the compressors, and this meter is read every night at midnight and 4 A. M. as a check in case of a bad leak occurring in the line. For 4 months the unaccounted for gas averaged 117,911 cu. ft. per mile of 3-in. per year. The line is operated at approximately 20 pounds pressure per square inch, and the material used was full weight wrought

iron line pipe, recessed couplings, Dresser fittings and standard full weight cocks and valves. The laying of the main was carefully supervised, and all tested with 70 pounds air pressure.

Mr. J. A. Perry (Philadelphia): A recently tested 12-in. screw pipe line, about 6 miles long, no service connections, and laid for transmission of gas at 5 pounds pressure, gave an equivalent leakage of 28,000 ft. of air per mile of 3-in. main per year, or about 40,000 ft. of gas per mile of 3-in. main per year. Every precaution had been taken to make this screw pipe first-class work.

On page 947, Mr. Shattuck does not cover very specifically the transmission of gas from a manufacturing plant to points of distribution. Many of us have plants which will have to be shut down because of their location in a residential neighborhood. The new plants must be located some distance away. If we build the transmission lines large enough to be adequate 15 or 20 years for transmission of gas at 5 pounds pressure, a large sum of money will be required. It seems to me that in these transmission lines, we will come to laying a tight main of moderate size with future use of at least 20 and perhaps 30 or 40 pounds pressure between the manufacturing plant and the point of delivery.

Mr. H. C. Palmer (Buffalo): I would like to ask if Mr. Shattuck will tell us a little more about how he obtained the amount of unaccounted for gas on the non-welded line.

The only experience we have had of high pressure distribution was the distribution of Pintsch gas. We transmit that about ¾ of a mile through a 2-in. extra heavy, wrought iron pipe, laid in cement grout, and we test this every day with a Bristol gauge. We shut the line at both ends and record the pressure on it. We can leave it shut off from one to five hours, and we seldom, or never, find that the pressure drops the thickness of the line made by the pen on the chart. While I suppose that our construction would be a very expensive one for a long line, it is entirely successful with us.

Mr. R. H. Garrison (Atlantic Highlands, N. J.): My ex-

perience with a system of about 80 miles is that the saddle is the weakest point. We have had a good deal of trouble with saddle leakage. I would like to ask Mr. Shattuck whether he would consider welding now a system which is built like that?

Mr. E. H. Earnshaw (Newark): I would like to ask Mr. Shattuck whether he has had any experience in welding pipe larger than those given in this paper. When you come to sizes larger than the 4 and 6-in., the cost of welding becomes a very serious consideration. The Public Service Gas Company had occasion, in 1913, to lay about 26,000 ft. of 8-in. steel main to carry up to 30 pounds pressure. We had heard a good deal from Mr. Shattuck about the advantage of welding, and we thought if it were possible, we would like to weld this main. We had no experience ourselves in doing this work, so it seemed to us that the best way would be to get some concern accustomed to welding, and have them do the work for us. We obtained bids from a number of people, and the very best price quoted was $4.00 per joint, the welding concern furnishing only the materials for welding and the man to handle the torch. As it costs about 80 cents per joint for screw pipe, we did not feel warranted in going to so much additional expense.

During this past summer we had about 1,000 ft. of 16-in. main to lay on a long bridge, and circumstances made it desirable to weld the joints. The work was done for us by contract, and cost us $7.63 per joint for welding materials and time of welder.

There were 42 joints, in 24 of which the pipe could be rolled so as to bring the weld always on top of the pipe, and 18 had to be made with the pipe stationary.

The Chairman: Undoubtedly the question of cost is one which is to be considered very carefully.

Mr. G. I. Vincent (Des Moines): I would like to know if Mr. Shattuck or any one else here has had any experience in welding cast iron main joints?

Mr. O. B. Evans (Philadelphia): Some time since, with

a view to making an absolutely tight and permanent joint in cast iron mains, an attempt was made to weld two spigot ends of a 30-in. pipe by means of the oxy-acetylene flame. This work was done on the shop floor under working conditions much better than could be expected in practice. It was found that after about 12 in. of the circumference had been welded, any further work caused the original weld to split open. Apparently the strains set up by the intense local heating were sufficient to break the weld. The matter of welding large cast iron mains has also been taken up with various welding concerns, and in their opinion the proposition is not feasible.

Mr. F. N. Speller (Pittsburgh): On page 978, the tests shown indicate the weld to be as strong as the pipe. There is nothing said as to the sectional area of the weld. Evidently, though, from the photographs, the sectional area across the weld is greater than across the pipe. I would like to know whether there is any fixed ratio for these areas, or whether the operator intentionally builds up the weld to a certain extent thicker than the pipe. An experience we had in refrigerator coils prompts this question. The operator was content at first with simply filling up the V-shaped gap to the thickness of the pipe, and when the weld was tested under 300 pounds air pressure, a certain percentage leaked, and we had to go over it again, and found that it was necessary to put in 30 per cent. more metal than the thickness of the pipe. Incidentally, I might say the weld is not usually as strong for equal sectional area as the pipe stock, according to our own tests; you are testing a cast metal against wrought steel, and unless you do some work on it, you cannot expect to get the same strength. Another question I would like to ask is whether the operator uses a hammer and hot forges on the weld before it cools down to a red heat, in order to improve the texture.

The Chairman: If there is no further discussion, will Mr. Shattuck take the floor?

Mr. Shattuck: There was one question that was not covered,—the fact of the possibility of removing sulphur under

high compression. Mr. E. C. Jones mentioned that in a paper in 1906, and I will read you a few notes on this subject.

"High compression would undoubtedly liquefy sulphureted hydrogen, but inasmuch as it would also liquefy the valuable components of gas to a large extent, drawing off of the liquid sulphureted hydrogen would be accompanied by a removal of the condensed constituents, leaving a very lean gas. If the condensed products were not withdrawn, the sulphureted hydrogen would re-evaporate with released pressure and re-appear in the gas.

"There is a possibility, of course, that the sulphureted hydrogen might enter into combination with some of the other constituents in the gas, making organic compounds after the order of the mercaptans. It is hardly possible, however, that these would be desirable constituents."

On page 950 I want to call particular attention to the method of installing service pipes through walls. Those who have service pipes that have been in 20 or 30 years, or more, often find the pipe is so badly rusted that it collapses as soon as you put a wrench on it. You can imagine what is going to happen to you with rusted high pressure services. I think this is good practice, even with a low pressure service. The house may have been built in the winter time, with salt in the cement.

On page 963, the cart shown, frame work and all, was welded instead of rivetted to save time.

Page 967 shows the sleeve that we are using over existing Dresser joints or expansion joints, where we know we are going to have trouble with them, and which sometimes are on lines where we cannot shut off the gas. The drawing shows a slight flare. That should be straight. The sleeves should also be tapped with a small ¼-in. hole that can be later plugged and welded, or perhaps simply plugged, in case the joint does not begin to leak during the process of welding.

Mr. Keppelmann, who is going to speak later, read a very interesting paper before the Pacific Coast Gas Association, and

in that paper gives a great deal of detail about handling acetylene and a welding torch.

The weak point in a complete main welded and service welded line is the curb cock and the corporation cock. Under high pressure, the curb cock that is used often is going to leak, and you will have to have something better, if you are going to a higher pressure than 30 lbs.

Outside of using your welding outfit for welding your mains and services, there are a great many incidental uses for the torch around the plant. One particular use we have is for making special fuel burners. You can weld burners together easier than fit them together. Cases have come up recently where we put gas in places we could not have put in a satisfactory burner if we had to use fittings.

Speaking of high pressure leakage in any large high pressure plant which has been operating for four or five years, I doubt if the leakage is less than 20 per cent. on screw and expansion joints and strap saddles. In small plants that I have examined, I found that the leakage has been as high as 40 per cent. That was due in some cases to the fact that they did not use the best recess line pipe, nor the best workmanship throughout.

Answering Mr. Palmer as to how we made the test on the 80-mile line, it was made between one and four o'clock in the morning, reading a Bristol recording gauge and then calculating the capacity of the line. There were a few private lights and a few street lights. We made what we considered an accurate estimate of their consumption. We cut the line up into divisions, put pressure on and located leakage, due to electrolysis, the existence of which had not been hitherto known.

Answering Mr. Garrison, I think it would be well for a company of the size of his to buy a small welding outfit and start welding the services at once. He says the saddle in some climates is the greatest source of leakage on high pressure. The co-efficient of expansion between the lead gasket and iron saddle is great, and most of the saddles will leak in the spring. We have not welded much pipe over 4 in. in size,

but have welded a good deal of smaller sizes and have welded large joints, two or three of them, but not enough to get a good idea of the cost.

In answer to Mr. Earnshaw's question, when we started to weld, we were frightened by the cost of employing outside welders to come and do the work. Naturally they are in the business to make money, are under large expenses sending their men around, and charge a pretty high rate for their services, so we found we could do the welding a good deal cheaper.

In answer to Mr. Speller, to make sure that the joint is properly welded, we add 30 or 40 per cent. more metal. From the samples in Fig. 13, it would indicate that we had made a perfect homogeneous weld. We do not use the hammer to do any forging.

I am able to give the following comparisons between the cost of screw and of welded pipe lines:

Cost of laying 27,456 ft. of 8-in. W. I. pipe with screw joints, pipe being in 20-ft. lengths, laid in the spring of 1911, including engineering and legal expenses, $35,425.67 or $1.287 per foot.

Estimated cost of laying an 8-in. line of equal length with welded joints, pipe being in 40-ft. lengths, all other conditions being the same, $33,760.17 or $1.23 per foot.

During the year 1913, the following pipe was laid with screw joints:

Size (in.)	No. of ft.	Total cost	Cost per ft.
2	6,501	$1,517.63	$0.23
1½	8,268	1,696.93	0.205
1¼	5,212	1,077.20	0.205

In the fall, the following pipe with welded joints was laid:

Size (in.)	No. of ft.	Total cost	Cost per ft.
2	3,466	$708.47	$0.205
1½	4,298	830.10	0.19

During the present year, our average cost for 1½-in. pipe with welded joints has been 20 cents per foot. This average is for a number of short extensions which we have been mak-

ing during the year. Our lowest cost per foot for an extension is 17½ cents, the highest, 28 cents.

For the 1½-in. pipe, the average cost covering a number of extensions is 19½ cents. The lowest cost per foot is 15 cents, the highest, 28 cents.

Mr. D. E. Keppelmann (San Francisco): I have read and re-read Mr. Shattuck's paper on welding, and first I would like to say that I think the Distribution Section should see that the Institute gives Mr. Shattuck a vote of thanks, because his paper is the last word in gas distribution—at least we think so. Autogenous welding is now indispensable in gas distribution. A distribution department is not complete without a welding outfit. We wonder now how we got along without one. I thought our work along this line would be a matter of interest to many members. We have in San Francisco to-day about 200,000 ft. of welded high pressure mains varying from sizes 2 in. to 16 in., the initial pressure on one 8-in. line being as high as 105 pounds to the square inch, so we had to find something to stop leakage. About four years ago autogenous welding was suggested by Mr. Leon Jones, Assistant Chief Engineer, Gas Department, Pacific Gas & Electric Company. The distribution department then took it up, and with the guidance of the chief engineer, Mr. E. C. Jones, we advanced rapidly. With your permission, I will now show you our progress with autogenous welding in San Francisco.

For the Panama-Pacific International Exposition, we have just completed 70,000 ft. of welded mains consisting of sizes from 2 in. to 16 in. We are at the present time welding 20,000 ft. of 2-in. on the Marina Esplanade of the Panama-Pacific International Exposition, which will be the source of supply for 350 high pressure gas lamps, the only lighting at this point of the bay. That is of interest to all gas men.

Fig. 1 shows a welding outfit complete, which costs $200.00, exclusive of the cutting torch, the expense of which is negligible. The small tank is atmospheric oxygen, the other acetylene. High pressure gauges to record the tank pressures reduc-

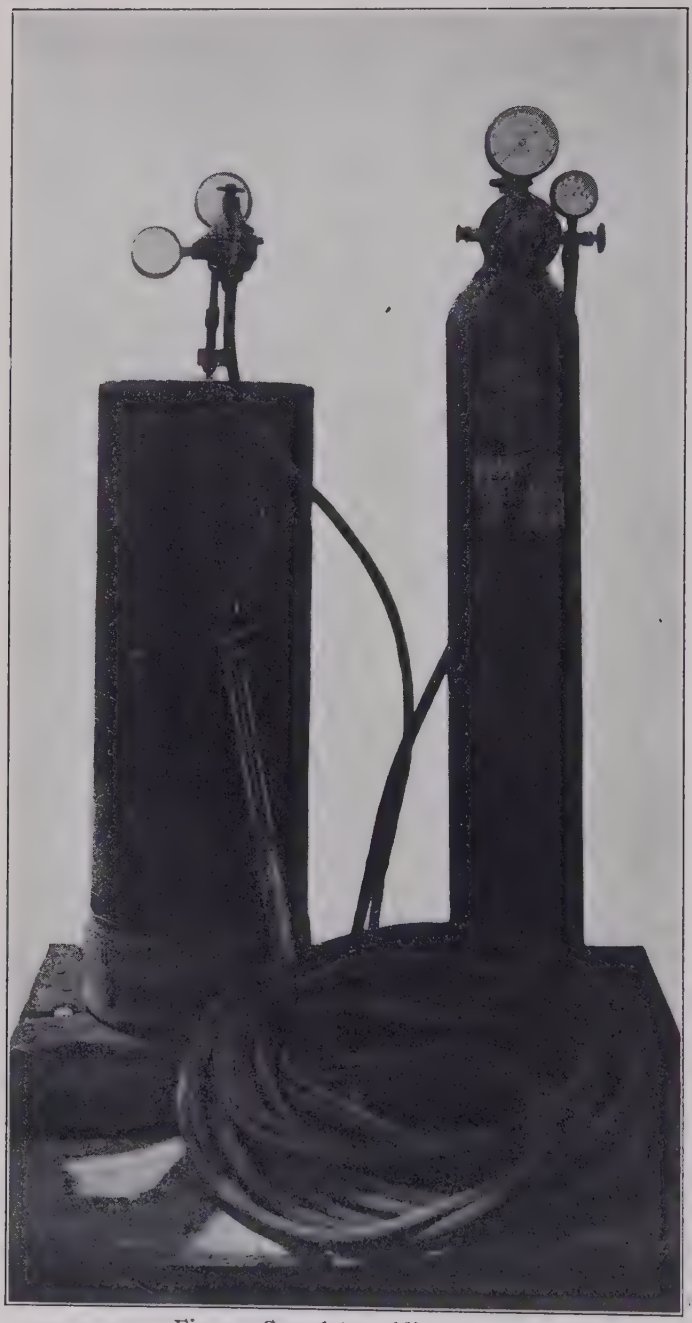


Fig. 1.—Complete welding outfit.

ing governors with gauges to record the working pressures, together with rubber tubing and torch, comprises the entire outfit. The oxygen is regulated to a working pressure of 16 lbs., and the acetylene to approximately 5 lbs. The first tubing purchased was known as armored hose, because of its durability. However, it was too heavy and caused the welding torch to unbalance, this being a detriment to the operator. Later, common rubber tubing at 6 cents a foot was purchased, which is entirely satisfactory. The picture shows the simplicity, compactness and portability of a welding outfit.

Fig. 2 is presented to show our advancement and to save money for those who may be interested in the immediate future. The large tank is electrolytic oxygen at 300 lbs. per square inch, and the small one immediately in front is atmospheric oxygen at 1,800 lbs. They each hold 100 cu. ft. The other tanks contain acetylene, the smaller one 300 cu. ft. and the larger 500 cu. ft., both at 300 lbs. to the square inch. The larger one you purchase outright from the Commercial Acetylene Company; costing us in San Francisco $236.00, including freight. The Prestolite Company is now renting the 300 cu. ft. size, which we find more convenient, at considerably less cost. They will rent each tank to you for $40.00, and then all that is necessary is to send them the empty tank; they will change it immediately for a filled tank, just as they change your automobile acetylene cylinder. I mention this to save you a great deal of money and considerable inconvenience.

Fig. 3 is a little portable conveyor we made ourselves. It is welded throughout. You will find that you will need it. This brings about the question of the acetylene generator on the job. We do not recommend it. We used one first, but have discarded it. Manufacturers will tell you that it costs you less than 1 cent a cubic foot to manufacture acetylene on the job. That is very true, but they fail to tell you how much per cubic foot the gas is costing you at the joint. After you generate acetylene on the job—not a safe operation—you must pipe to the various joints, which will cost over 2 cents per

Fig. 2.—Oxygen and acetylene tanks.

Fig. 3.—Portable acetylene conveyor.

cubic foot. The acetylene tank eliminates all these features.

It has been said by a number of people that welding under 4 in. is not practicable. We are at the present time, as mentioned before, welding 20,000 ft. at the World's Fair and 20,000 in another location. Fig. 4 shows the operator welding a 2-in. cross.

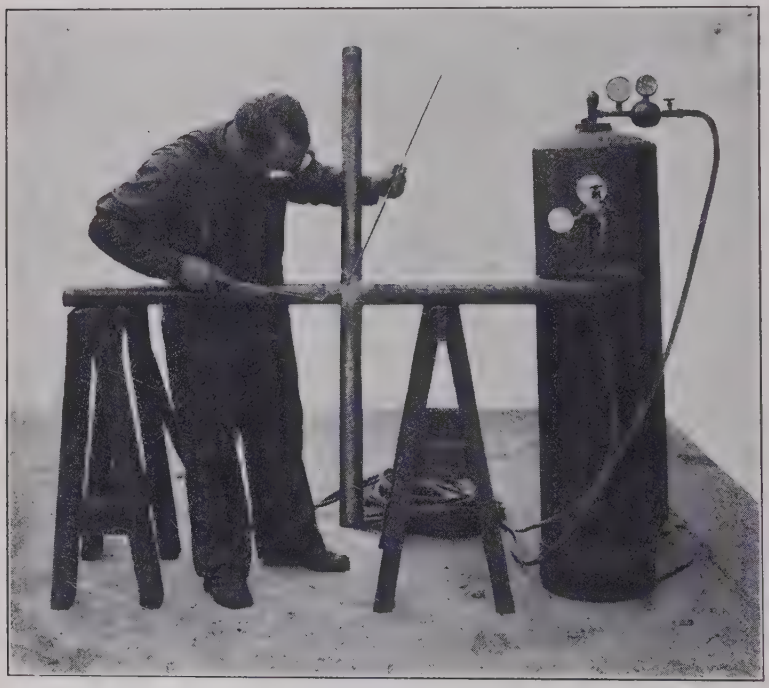


Fig. 4.—Welding a 2-in. cross.

Fig. 5 shows you the various kinds of fittings, 2- in. cross and 2-in. drip, ready to place in position; 8-in. by 4-in. reducer, O. D. pipe; 6-in. by 3-in. special, I. D. pipe, showing you can do anything with any kind of pipe. To-day we have no preliminary surveys, nor do we need to make patterns and castings, which invariably leaked after installation and had to be replaced, with loss of labor, time and money. When we come

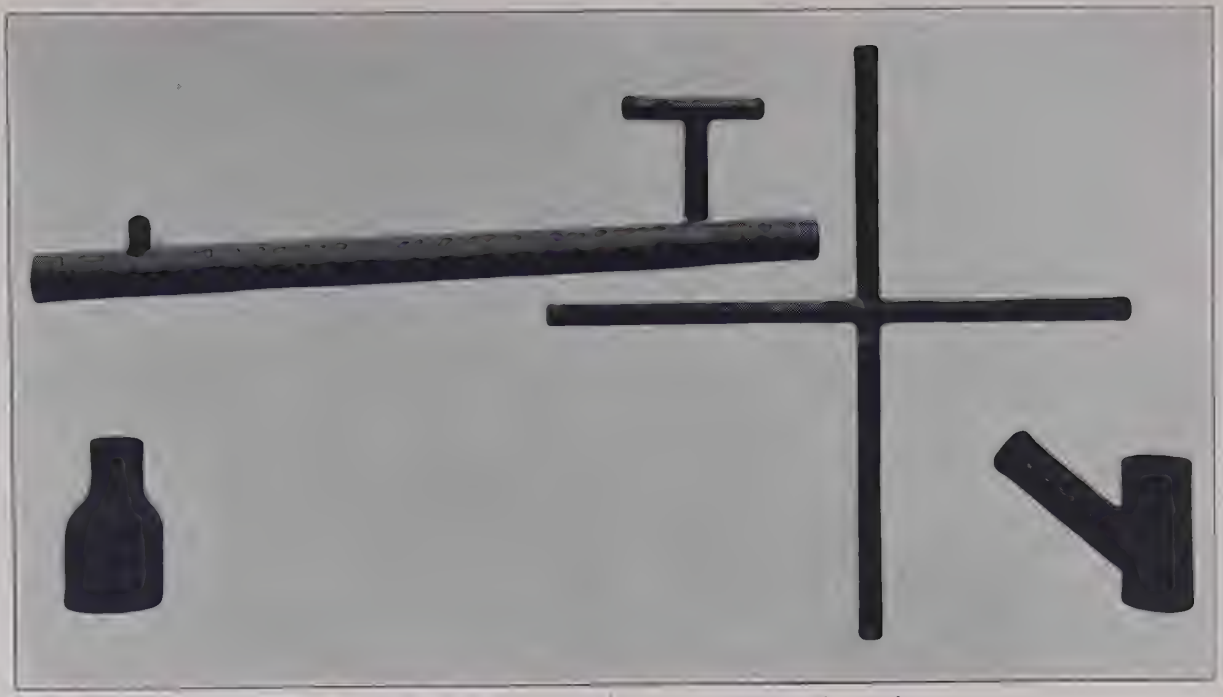


Fig. 5.—2-in. drip, 2-in. cross, 8-in. x 4-in. reducer, 6-in. x 3-in. Y.

to a corner or an intersection or any obstruction of any kind, and find we need a special fitting, we make the fitting out of the pipe being used on the job.

Fig. 6 is the special inserted right in position. I wish I could have taken the picture of that particular intersection. There are four laterals from it, and those two specials are inserted in a line just at this street crossing.

Fig. 7 shows an 8-in. I. D. connection taken off an 8-in. O. D., at an angle of 90 degrees. These pictures are in answer to a number of inquiries we have received from all over the United States.

Fig. 8 is a service connection. This particular one is a 3-in. supply for one of the large palaces at the Exposition, taken from the 8-in. main line, showing the valve with its standard flange screwed into the standard I.D. pipe and welded to the O. D. It shows the weld very plainly.

Fig. 9 is the method of connecting an 8-in. valve in the line. When first the question arose as to how we were going to make the connection, we, as usual, had to call on the "chief." He came out and took a look, "Why," he says, "the standard I. D. pipe screwed into your companion flange, slipped over the O. D. and welded." Since that time it has become known as the Jones' slip joint. The by-pass is always installed on the valve before the valve is turned on, the high pressure being turned around the by-pass, and the pressure equalized on both sides of the valve before the disc is lifted.

When we come to street corners or places that require a bend, we don't have one made before, nor are we disappointed in not having it at the time it is needed. We bend one cold right on the job, with the assistance of a hydraulic jack, this bend in Fig. 10 being an 8-in. O. D.

A short time ago it was imperative that we install at once, a drip with a capacity of 400 gallons. It would have taken three weeks to get one, at a cost of $400.00. We had cut some holes in some old 16-in. pipe in stock, welded the heads into those holes and installed the drip (Fig. 11) at a cost of approxi-

Fig. 6.—8-in. cross welded into position.

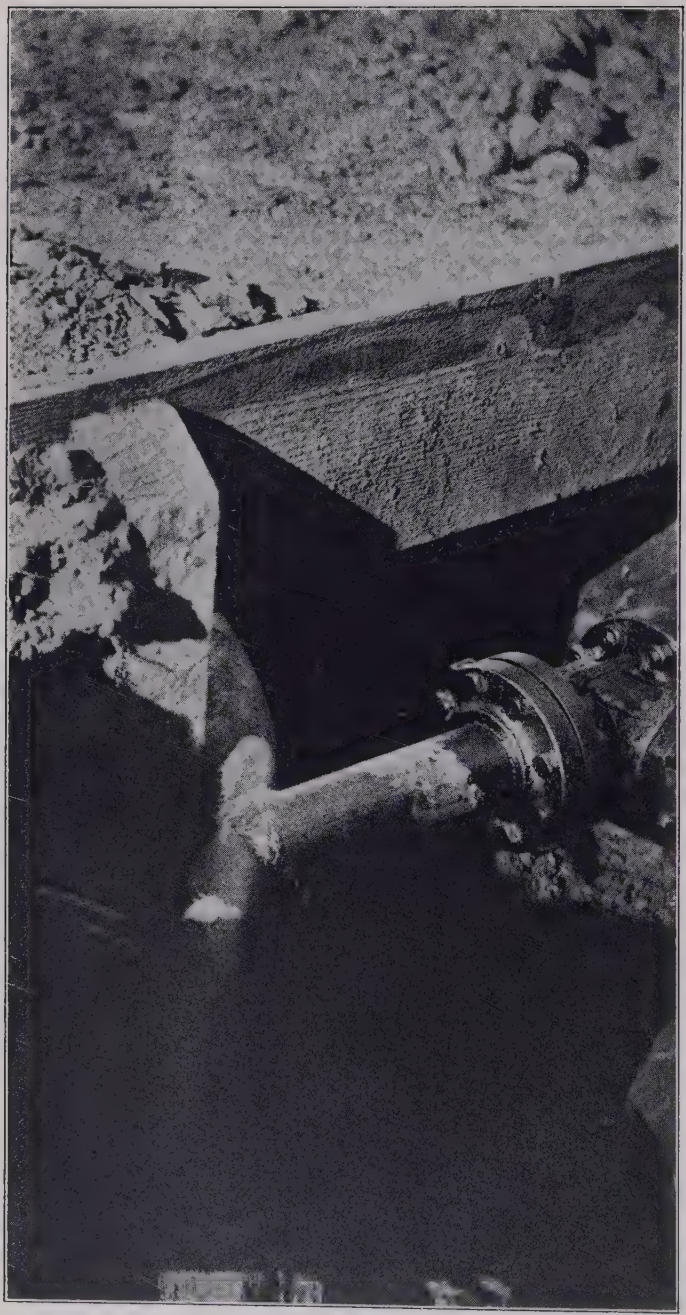


Fig. 7.—8-in. O. D. main line welded to 8-in. I. D. branch line.

mately $100.00. Our welding costs vary from 25 to 75 per cent. less than the cost of former methods.

Fig. 12 is a governor connection. Instead of the old method

Fig. 8.—Service connection.

of fitting, you will observe that it is welded throughout. The necessary connection is measured, welded above ground in one piece and dropped into position, after which it is coupled

up with the only fitting used, this because of the necessity of having to replace the governor at a moment's notice.

Fig. 13 is a district governor pit and high pressure governor

Fig. 9.—Jones' slip joint.

of which we have quite a few. The old manner of connecting was to fit directly from the high pressure line into the district governor. Occasionally we find the district governor unseated.

I was called away from home at one or two o'clock in the morning, very often on account of the high pressure gas passing

Fig. 10.—Pipe bent on the job.

into the low system. Since it was compulsory to install a drip irrespective of the method of connection, we, therefore, connected the high pressure line directly into the drip, the gas going from the drip to the district governor. Since that time,

we have never had a district governor unseated, and we carry from 40 to 105 lbs.

Fig. 14 shows 1,000 ft. of 8-in., welded on timbers thrown

Fig. 11.—Drip made of two lengths of 16-in. pipe strapped together and welded.

across the trench. After welding, whether in 1,000 or 4,000-ft. lengths, depending on the obstructions we may find, the

Fig. 12.—High pressure governor connection.

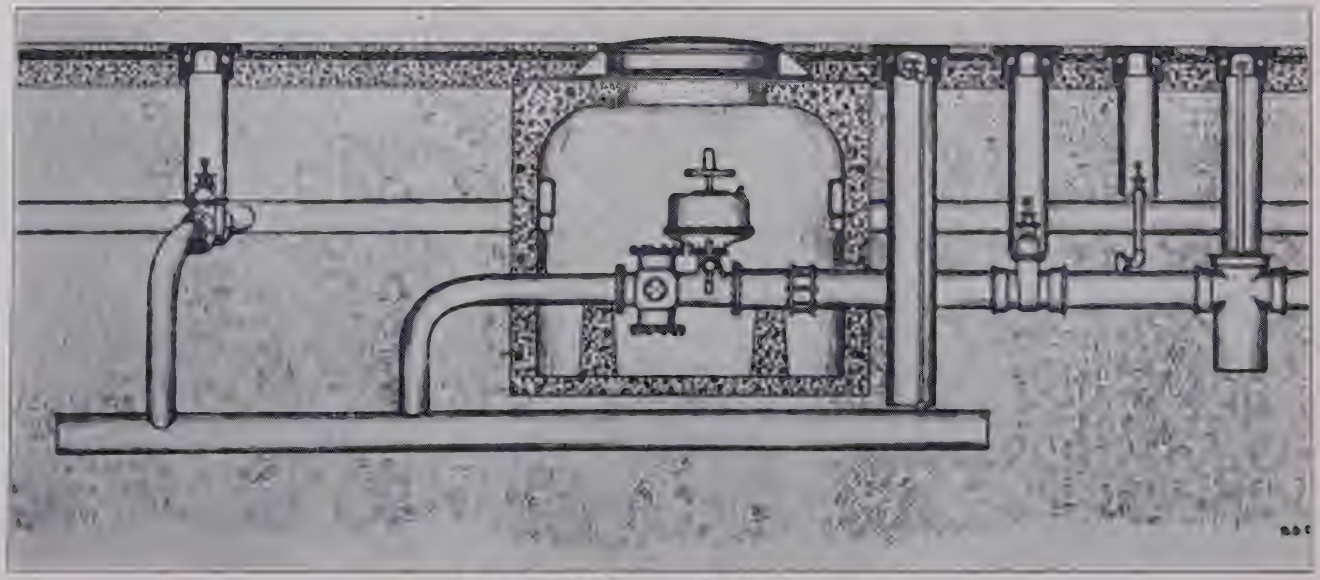


Fig. 13.—High pressure district governor.

Fig. 14.—1,000 feet of 8-in. pipe welded over the trench.

Fig. 15.—4,000 feet of 8-in. pipe welded on top of the trench.

skids are pulled from beneath, and the pipe dropped into the trench. At first, the pipe was dropped carefully, but later, thrown into the trench, for it was infinitely better that any defects which might exist, should be known before backfilling.

Fig. 15 we consider the record weld, 4,000 ft. of 8-in. continuous steel tube welded on top. This particular line was laid in a windy and very sandy country. After welding, we merely dug the sand out from beneath, to the depth of the trench desired, after which the wind very nicely came along and blew the sand into the trench. (Laughter.)

Fig. 16 shows a bird's-eye view of 16 in., showing the operator in position, the outfit and the weld.

Couplings formerly used by us cost $4.00 in San Francisco. The welded joints on this main (Fig. 17), just laid, cost us $2.35 per joint. The original 8-in. welded joints we had done by contract, as we did not know anything about welding. The contractor wanted $5.00 per joint. We told him that was prohibitive. He finally said, "Well, $4.00." That did not sound good, so we showed him a Pacific Service magazine, published by the Pacific Gas & Electric Company, wherein reproductions of his work would be published, and that he would become a famous man. He said "$2.50 a joint." He welded a mile of 8-in. O. D. pipe just 4 years ago, the first mile of 8-in. laid in San Francisco. That same joint, gentlemen, we are doing to-day ourselves for 70 cents. And permit me to mention this also, that in San Francisco we pay our fitters $3.75 a day of 8 hours and our laborers $2.75 a day of 8 hours, as against your $2.50 for fitters and $1.50 for laborers a day of 9 or 10 hours.

On the question of tests: We formerly had an outfit in which we tested our welded main for three days at 150 lbs. per square inch. To-day we have four welders, two of whom are fair, and two are experts, so that to-day we do not test the welds they make. One welded main was 33,000 ft. long. We did not test it, and not a single leak developed. It contained two district governors and four valves. On the Panama-Paci-

Fig. 16.—Welding a 16-in. joint.

Fig. 17.—16-in. welded main

fic Exposition site, where we have welded 70,000 ft. by this time, we did not make any tests whatever, and our first 50,000 ft. did not produce a single leak.

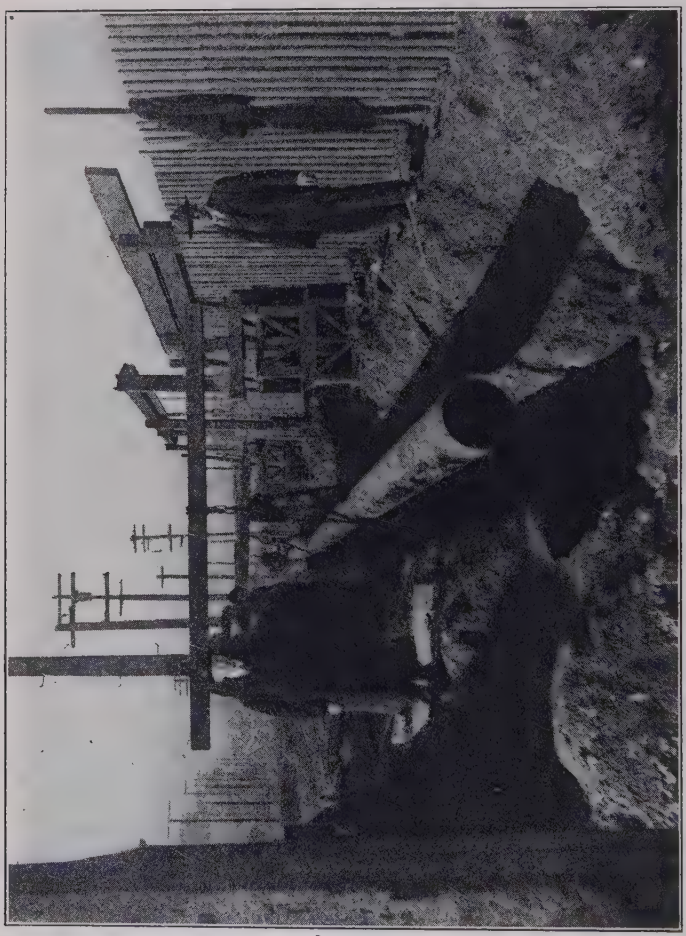


Fig. 18.—1,000 lbs. of 16-in. pipe hanging on a welded joint.

Fig. 18 shows the 16 in. you saw before, and being so heavy, it is welded on large timbers across the trench, then hung on chain blocks, after which the timber is pulled out. This par-

ticular length of 16-in. pipe, 20 ft. long, weighing 1,000 lbs., is hanging on its own welded joint. The chain catches the pipe just behind the weld. That we consider sufficient test. That joint, including labor and material, costs just $2.35 and is permanent, as against $4.00 for a single coupling, which has proven unsatisfactory.

Fig. 19.—Welded oil seals.

Also, with high pressure installations, oil seals (Fig. 19) are a necessary evil. Formerly, we fitted these together with pipe and fittings. We now make them out of scrap pipe, welded at half cost.

A short time ago it was necessary, due to city construction, to remove 7,000 ft. of 24-in. cast iron pipe. Unfortunately,

it was near a car track, and you could not use wood to burn out the joints, nor is it practicable to use a welding torch, because the heat is so intense, being 6,300° F. You would burn through your lead very quickly and melt it around through

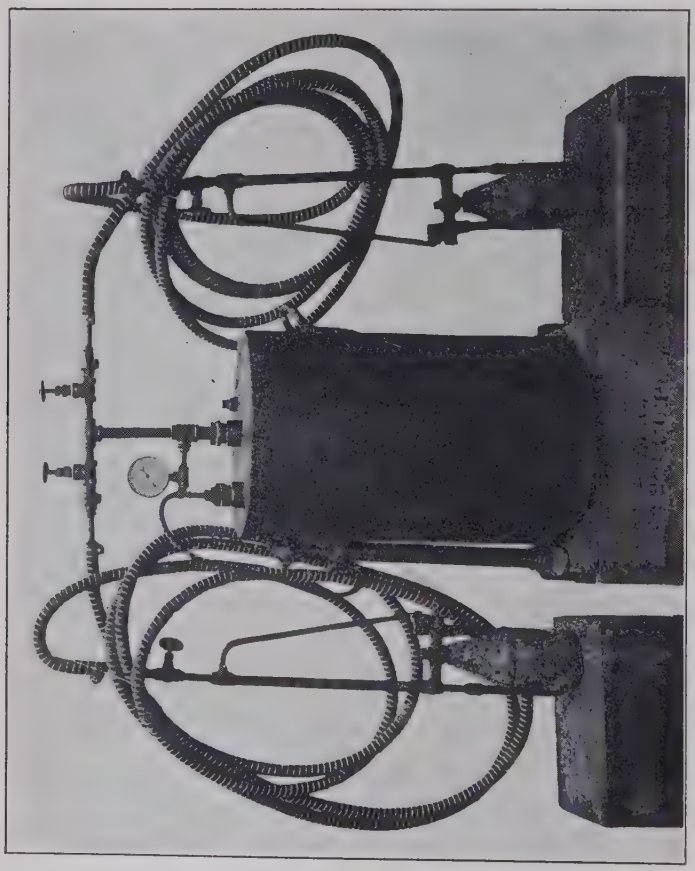


Fig. 20.—The Hacker blow torch.

the other portion of your joint. The result is you would be melting and remelting your lead. I tried two small kerosene torches, but they were too small for my work. A larger one would have cost $150.00. We found some old 16-in. pipe in the yard, welded heads in, burned holes through the head and

welded some old sockets in place, found an automobile pump and welded it to the side, and it works beautifully. That job (Fig. 20) cost $15.00.

We formerly bought a bell pump for $18.00. After several weeks rough handling, the fitter returns for a new pump. We

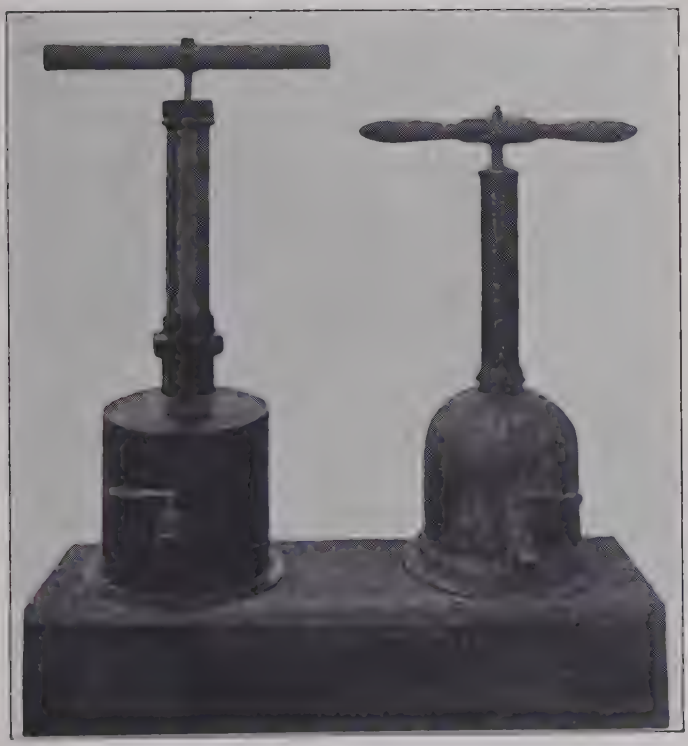


Fig. 21.—Welded bell pump (at left).

got tired of that, found some old 8-in. pipe, welded a head in it, and it cost us $5.00 (Fig. 21). The fitter may abuse it for the rest of his natural life, as the welded pump is practically indestructible.

As I said before, you will find a welding outfit indispensable, whether it is in your distribution department, your blacksmith

shop, your automobile garage, or anywhere. We receive repairs from all over the Pacific System, except the works, which has its own outfit. Our garage has 175 cars, and we help to keep them moving with our welding outfit.

Some time ago, the American Can Company insisted that their four 300-light meters be moved a distance of 100 ft. The existing installation was made with fittings before we knew anything about welding. The change had to be made in not more than 3 days,—Sunday and two other days. The estimate for a fitting installation was approximately $250.00. We cut the house line. You will see (Fig. 22) the weld on the corner; you will also see the weld on the inlet header. We cut both headers, moved them back about 100 ft., inserted 100 ft. of 8-in. O. D. pipe, slipped into the I. D. pipe, and welded. That gave us our inlet connection The house line was cut off 100 ft. and then hooked up to the outlet header. The job was done on Sunday, with no inconvenience to the consumer, and at a cost to us of $75.00.

Coming to the question of meter sets. You also have large apartment work, as we have in San Francisco, where we install pretty nearly every day in apartment houses, 60, 70, 80 or 90 meters. We have one welder who does nothing else but weld apartment distributors. We do not fit headers in San Francisco. All realize the work in connection with the former method of fitting up headers with pipe and fittings, pipe to be cut, threads cut and fitted together with fittings, and then invariably leaks. This method is now obsolete in San Francisco, our headers being welded throughout. The pipe marked (Fig. 23) is merely marked to show where the welder will cut with his cutting torch. The two on the end are to receive the second and third bank of meters. The length of the pipe is determined by the number of meters to be set, and consequently, determines the number of banks of meters to be added. We formerly took three pieces of pipe and welded them together. The result was the pipe buckled. Instead of welding the three pieces together now we make a large mitered joint,

which is the inside mark on both ends of the pipe. The operator using a cutting torch, cuts out the pipe as shown with the chalk marks. The legs are merely bent at the mitered joints,

Fig. 22.—Four 300-light meters welded into position.

and then welded. The two small pieces of pipe are added to the holes, making a second and third bank for the reception of the meters.

Fig. 24 shows you the manifold ready and welded.

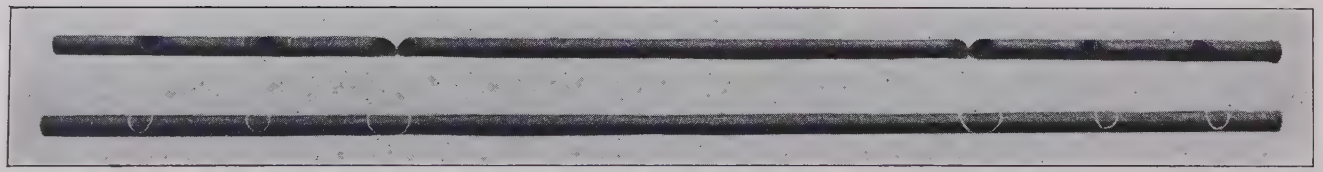


Fig. 23.—Pipe for making manifold.

The cutting torch is now used to cut holes into the header

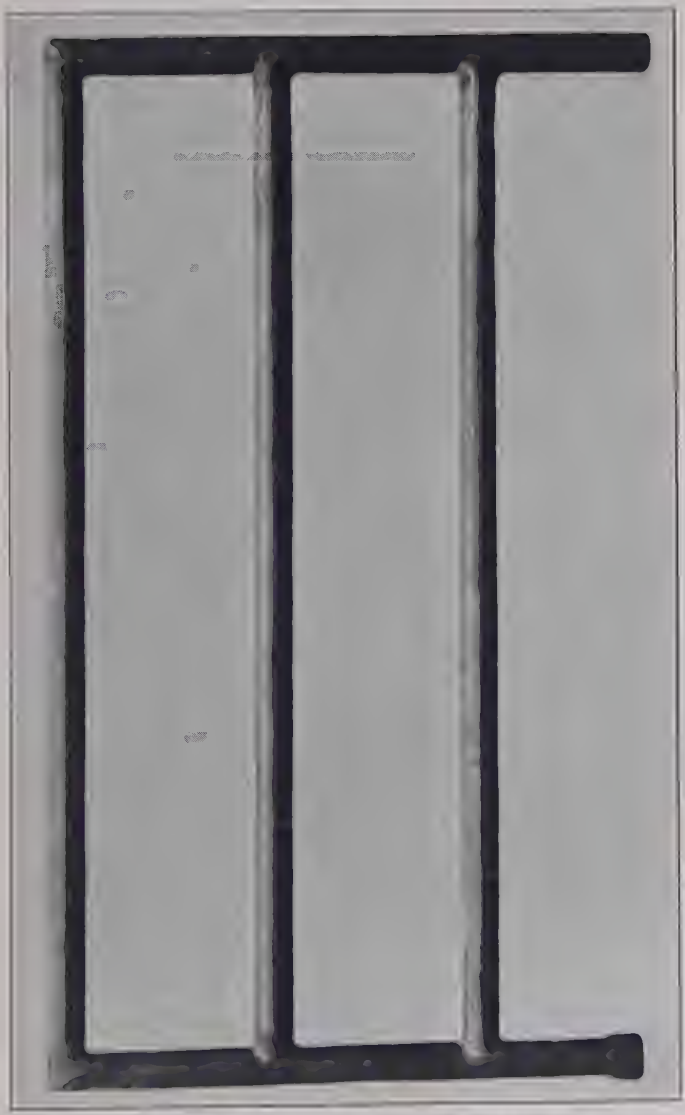


Fig. 24.—Manifold welded and ready for holes.

(Fig. 25). After this, sockets are cut in half, welding one-half

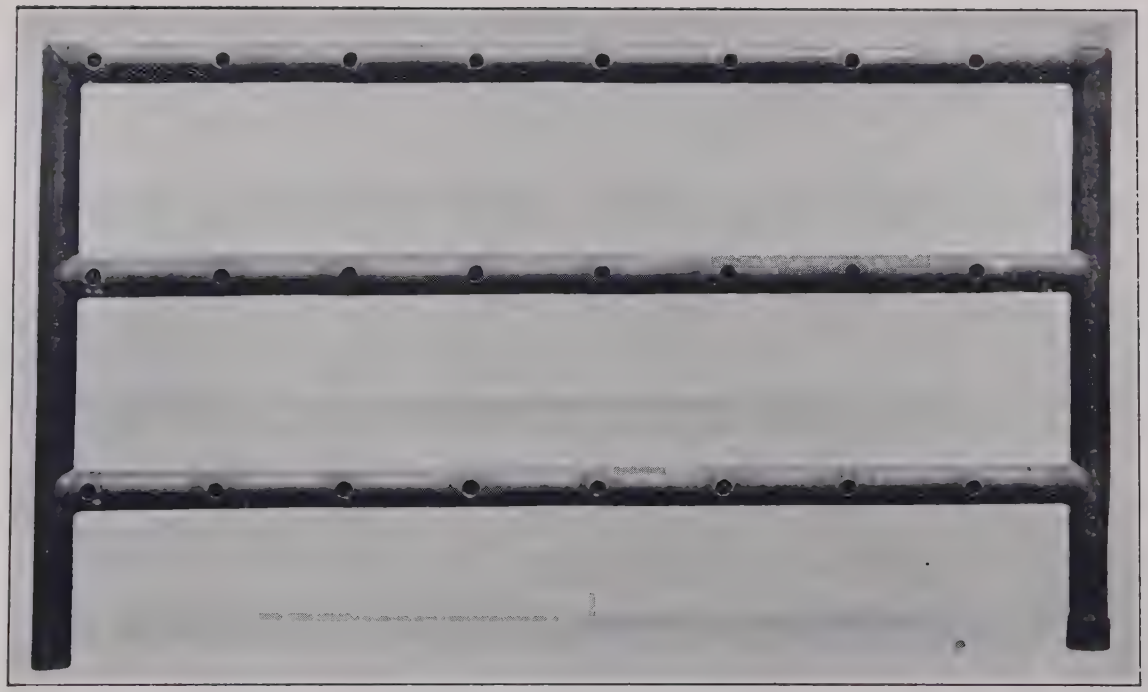


Fig. 25.—Header with holes burnt in.

to each of the holes, forming the inlet connection. You will find a thread on one end of the header. The service department proceeds to install the service from the main, to just

Fig. 26.—Meters in position on a welded distributor.

inside the building line. The welder had previously welded up his distributor. The distributor completed, is moved to the location and connected with a running screw. You now have the installation of the meters set on the welded distributor

(Fig. 26). We formerly had trouble to locate meters in consumers' premises, since they did not care to have the poor despised meters set in any exposed locality. We have no trouble now, for a welded distributor makes a very neat and workmanlike appearance.

A short time ago, our electric department sent in an order to our blacksmith to cut thirty covers for their manholes. It took the blacksmith and helper five hours to do the work. We asked for the next order that came in, our one operator completing the order in one hour.

While working at the Panama Exposition, one of the contractors installing the water line in one of the large palaces had a leak in his 6-in riser. He was particularly anxious, because the time of his contract was about to expire. He came to us very frantically. He said, "I want you to weld this up for us, because we have not the time and this has got to be done to-day; we cannot do it in less than several days, and it will cost probably $250.00 to cut out the split length, and connect with flanges." We sent our portable outfit, and welded the seam; nothing was lost and nothing thrown away. I met the contractor the day before I came to the convention, and he said, "You have not sent me the bill." I said, "How much did you say it was going to cost?" He said, "$250.00." I said, "I am ashamed to send you the bill. Our cost was 50 cents." You must by this time realize the indispensability of a welding outfit.

(Loud and prolonged applause.)

Mr. G. B. Bains, 3rd. (Reading, Pa.): Welding of high pressure mains may be the "latest word in high pressure lines" and is without doubt excellent practice. I think, however, that Mr. Shattuck is a trifle severe in his condemnation of screw joints. Rubber gasket expansion joints do leak, but if they can be eliminated on welded pipe, there is no reason why they cannot be eliminated on screw pipe.

To avoid leakage on fittings, extra heavy flange cast iron fittings could be used instead of the usual fittings with rubber

gaskets. Such fittings should not leak. Standard weight pipe with taper tapped couplings is strong enough to stand any artificial gas pressure. I think extra heavy and special designed cocks and valves should be used. The ordinary valve and cock is not tight enough for high pressure. The double strap service saddle, if carefully put on, will not slip or leak.

The following suggestions might be added to those given by Mr. Shattuck in his paper:

Do not purchase pipe with the couplings made up at the mill, especially on sizes 4 in. and over. It is just as easy to make up the whole coupling on the ditch, and the chances are that the mill will strain the threads when screwing up by machine.

Do not use higher pressure than necessary. On a system that recently came to my notice, 30 lbs. pressure was formerly used, and 5 lbs. pressure is now used and excellent service is being given. Leakage is considerably lessened.

Mains should be laid with a covering of 3 ft. to 3 ft. 6 in. This will insure a good cover on the services. This is very essential at the present time, as with the Good Roads movement, roads are being remade and heavy steam rollers are being used to pack down the dirt. With shallow mains, services are likely to be picked up by the street plows or trapped by the weight of the roller.

Service blow-offs should be a size larger than the services, and the ell at the end of the blow-off should have a screen or gauze over it to prevent stoppage by insects.

Mr. Shattuck in his paper, under costs, cites one case where pipe was laid under very ideal conditions. It is hard to compare the cost of laying two separate lines of pipe, as conditions under which the pipe is laid, such as nature of the ground, etc., varies considerably. On a 4-in. line, 10 miles long, with screw pipe and expansion joints, the laying labor was 2.4 cents per foot. Total labor cost for excavation, laying and backfilling was 28.5 cents per foot. This was due to the fact that there was encountered 2½ miles of rock.

The trenching machine which Mr. Shattuck speaks of is

excellent if digging conditions warrant its use. I do not think a trenching machine, however, can be used if there is any rock at all. That has been proven in the instance mentioned above, where, instead of saving considerable money, the machine was an added expense, due to the fact that rock and more or less loose stone were encountered throughout the entire 10 miles.

THE CHAIRMAN: Gentlemen, you have heard this paper, and you have heard the able discussion upon it. I think the Distribution Section owe a vote of thanks, first, to Mr. Shattuck for having prepared his paper, and second, to Mr. Keppelmann for having brought his slides to show us the way they do the work in San Francisco. I would like some one to make that motion.

MR. VINCENT: I make that motion.

(Motion seconded.)

THE CHAIRMAN: Gentlemen, the motion has been moved and seconded. I would like to have a unanimous vote on that. All in favor please say aye. The ayes have it.

(Motion carried.)

THE CHAIRMAN: The next paper on our program is "The Installation and Maintenance of Services," by Mr. R. B. Duncan, of Philadelphia.

THE INSTALLATION AND MAINTENANCE OF SERVICES.

INTRODUCTORY.

In this paper I shall endeavor to explain and illustrate, in as clear and concise a manner as possible, the principles and practices involved in the installation and maintenance of services for the low pressure distribution of gas. A treatise on so old a subject can scarcely hope to give much that is new, but as old things need, from time to time, to be newly defined to suit changing conditions, my aim has been to give what I consider the best methods to be followed. Although considered by many as one of the minor departments of the gas industry, it is one in which a great amount of technical skill

and forethought can be exercised. Considering a department in which the practice is so extensive and varied throughout the country, it is remarkable how singularly scanty literature is on the subject. A thoroughly exhaustive treatment of the subject would occupy a much larger treatise than this; consequently, I have condensed wherever possible. My endeavor has been to go down to the first principles to make every step clear and intelligible as to the fundamentals involved, so that the beginner shall be able to obtain a good and broad grasp of the subject that will possibly assist him subsequently in the comprehension of details.

The author is under many obligations to Mr. Walton Forstall for the use of his manual on "Main and Service Work," for valuable suggestions and for his critical revision of this manuscript.

Synopsis.

It has been my endeavor in this paper not only to describe the method of installing and maintaining services, but, at the same time, to give the most efficient methods. Promptness, as well as efficiency, with complete satisfaction to the consumer, is the keynote of success between the gas company and the public. In service work, as well as in any other department of the gas industry, this holds true, and must be constantly borne in mind, the hearty co-operation with other departments being necessary.

I have begun the treatise with a description of the proper design of a service system, or, in other words, the general policy governing the various matters pertaining to such items as conditions affecting the size of service, location details, and installation in advance of paving. Under "Location Details" I have touched upon the most important conditions that are met with, affecting the position of the service, and have tried to explain how such obstacles are overcome. In these paragraphs, the question of depth of service and the use of stop cocks and valves are also discussed.

Although a very important subject, I have only touched upon the comparison between wrought iron, steel and gal-

vanized pipe, in the hope that it will be discussed freely by distribution engineers in October. Other material, such as stop cocks, valves and stop boxes, have also been described.

Tools used in the various steps have been described with photographs that give a good idea of their design.

I have brought to your attention such useful articles as the respirator, tamping machine, asphyxiation kits, etc., also transportation vehicles, under the heading of "Equipment."

In building up a force of men to do service work, I have given what I believe will take care of almost every condition; however, in building up such a force, it is necessary to be guided by the requirements as laid down by an adopted working schedule and then to build up a force of employees that will enable you to deliver this standard to the public at a minimum cost.

Describing the installation, I have gone a little more into detail in order that the beginner can thoroughly understand each step. There are various items under the heading of "Maintenance" that require more discussion than others, such as "Line-walking," "Methods of Handling Leaks and Insufficients" which will be given a more extensive discussion than such items as "Stop Box Inspection," etc.

Design of Service System.

Conditions Affecting Size of Service.

In the early stages of the gas industry, the size of a service to be installed was figured very close, but in later years there has been a much greater tendency toward making the installation one that is a little larger than is really required. The main reason for installing the smaller service was due to the high cost of wrought iron, but, at the present time, the difference in cost between a 1¼ in. and ¾ in. service, including the stop cock, is only 15 per cent. of the total cost of a new service, not including paving. To enlarge a service, through paving, will add about 100 per cent. to the original investment. After considering this figure, it is readily seen why it pays to install your service too large rather than too small.

The question of preparing a service schedule for a city or town is a very difficult one, about which there is much difference of opinion. It is essential, however, that a minimum size be determined upon for every town. The paving is really the point that decides the question. In small towns, under ordinary conditions, a 1 in. house service would be sufficient to supply all the gas that is needed. For larger towns and cities, 1¼ in. would seem very much more desirable. The apartment house plays a very important part in the solution of the minimum size of the service. Should a town be composed of more such buildings than of ordinary dwellings, of course, this point must be taken into consideration and a larger size of service decided upon. For lamp services, 1 in. should be used except where you know the lamp locations are subject to constant change, in which case, ¾ in. could be laid.

Below is given the schedule used in Philadelphia:

	Inches
Dwellings of 12 rooms or less	1¼
Dwellings of 13 to 20 rooms	1½
Dwellings of over 20 rooms, and not over 75 outlets	2
Stores, hotels, factories, etc., of 15 outlets or less	1¼
Stores, hotels, factories, etc., of 16 to 20 outlets	1½
Stores, hotels, factories, etc., of 31 to 75 outlets	2
Stores, hotels, factories, etc., of 76 to 130 outlets	2½

Size for Gas Engine.	Inches
Under 5 horse-power	1¼
6 to 10 horse-power	1½
11 to 20 horse-power	2
21 to 40 horse-power	2½

This table to be followed only when a separate service is installed to supply the engine.

The sizes given apply to services of 100 ft. or less in length, the measurement being made from the main to the inside of cellar wall; when a longer service is required, it is best to compute the size. Should it be possible to get the exact consumption of a building, it is always best to compute the size, allowing 1/10 in. drop in pressure for every 30 ft. of service. In making the Philadelphia schedule, the idea was based on the assumption that there should be no more than 1/10 in. loss of pressure in a service at the time of its maximum demand. Although the average length of service in Philadel-

phia is only 28 ft., the schedule is based on 1/10 in. drop for 100 ft., therefore, allowing a large margin. The schedule assumes, for instance, that a dwelling of 12 rooms, in common with a store of 15 outlets, will need, at some time, gas at the rate of 150 cu. ft. per hour. This consumption, through a 1¼ in. service 100 ft. long, will mean a loss of about 1/10 in. This assumption is more or less arbitrary, but must be considered in the light of the following facts: 97 per cent. of all the house services in Philadelphia are 1¼ in.; 1.4 per cent. are 1½ in.; 1.2 per cent. are 2 in.; 0.4 per cent. are larger than 2 in.; therefore, the amount to be gained by raising the upper limit of the various sizes is of little value and the schedule as drawn allows, in many cases, ample leeway for the use of instantaneous water heaters and other large gas consuming appliances without the expense of service enlargement. It is very important that the size be large enough to meet the probable future requirements, because not only does the cost of renewal increase with the length, but also the loss in pressure produced by a given percentage increases in demand. Large gas consuming appliances are becoming more popular every day, and considering the long life of a service, during which many new developments are liable to take place, it is wise to be very liberal in regard to the size, especially in long services.

In Philadelphia, during the last year or so, our company has acquiesced to the pressing demand of owners of large buildings to connect a service or services to what is termed a "common riser" or risers, as the case may be; a better name for such a riser would be "common service." It runs from the basement to the highest floor with outlets left on each floor to allow the consumer or lessee of the floor, the privilege of having his meter on the floor he rents instead of being set in the basement. The installation of the proper size service in these cases is very much of a problem. Many times, several floors are occupied by concerns using no gas when the service is first installed; suddenly they move out and a new tenant rents, re-

quiring a great amount of gas, so that our ruling is to be very liberal in our estimation of the probable amount of gas that is liable to be consumed in such a building.

Installation in Advance of Paving.

As a rule, the average length of services in large cities does not run much over 15 ft. in the roadway. Considering this short distance, and the many conditions affecting service locations, it is not advisable to run services ahead of paving in advance of building operations. Many times, even when plans are submitted, something goes wrong, failure of builder or decision to build one less or two more, houses, which will throw your entire operation out with a loss of a great amount of money.

Services run in advance of paving are generally run in pairs, the intention being to have a service each side of the division wall. As these services would only be run to the curb line, no end of trouble is encountered when the time arrives to extend them to the desired location. The practice of offsetting from the curb to the cellar wall is a bad one, and, in many cases, offsetting would do no good as your stop box would be found on the wrong property, causing a great amount of future trouble. When one side of a street is built up before paving, by laying the main on the opposite side, you will run your long services before paving, leaving only the short ones to be installed. Should your paving go down before being compelled to run the short services, only a small amount of paving is involved. If, for any good reason, the services are installed ahead of paving, they should be run to a point inside the curb, about at the location of the future stop box.

In cases of renewal of sidewalk paving, it is always good practice to determine whether it is advisable to renew or enlarge service to this dwelling before said work is started. The age of service and consumption of consumer will determine this point.

Location Details.

House Conditions.—In Philadelphia, the rule commonly

followed, is one separate service to every house; however, a corner property, facing on two streets, is entitled to two services, one from each street. There are a few exceptions to these general rules that I will endeavor to explain:

In supplying gas to houses that are practically rear buildings, it is necessary, very often, to extend from the front house and possibly run through the yard to the house in question. In cases of this character, the meter generally sets in the front house. The question of installing services to houses that are built facing on a footway or alley, probably not over six feet in width, has become quite a business, especially in Philadelphia. It is no rare occasion to find from ten to twelve small houses in these alleys all anxious to use gas. In these cases, we install what we term an "Alley Run." The service is run from the street main and acts as a common supply, the individual service to each house being taken off this supply. When the pipe is laid, a tee is inserted for every house, whether desiring gas or not. Unless the width of the alley is too small, a stop cock is put on each service.

At this point, the question will arise as to why it is not good practice to use one pipe as a common supply for part of its length to *two* or *more* houses. The most serious objection against this installation is that in case of poor supply to one of these houses, in attempting to clear the service, the supply to the other houses may be interrupted with the danger of serious consequences. The objection, in my mind, seems serious enough to warrant the installation of two separate services for, under ordinary city conditions, the additional expense is very small. Should the houses be detached, or semi-detached, with possibly large front lawns, a considerable amount of money would be saved by installing a common service. In this case, a common pipe could be laid, if possible, along the division line of the pair of semi-detached houses, branching off somewhere inside the curb to go one on each side of the division wall. If the houses are detached, the common pipe would be laid along a line passing between the houses, and would branch off probably at right angles, just past the front wall line, each

branch entering at the side wall. In both instances, if stop cocks are used, they should be placed after the service has branched. When installing a separate service, it is well to bear in mind that its location is affected by both internal and external conditions of the house. In rows of houses, in order to save digging, one trench along the division wall will answer for a pair of services. It is advisable never to place the pipe under the pillar between the windows, unless an opening in the wall has already been provided. Where no opening has been provided, it should be placed under cellar windows or under steps, if latter are in course of construction. Avoid weakening foundations of steps and porch columns, also endeavoring not to have head of service in coal bin. The service should also be so located, if possible, that its end in the cellar is to the left (as you face the street) of the end of the riser, and within two feet of a plumb line dropped from the end of the house riser, measured in a horizontal line along the front cellar wall.

As corner properties are generally much larger than the adjacent buildings, two services into this building, provided there is a main on each street, will save considerable money in the cost of the house piping; however, should there be but one service required, it should be run from the street involving the smallest cost.

Foreign Structures.—As in the case of mains, a location near other structures is not desirable, so it should be with services. In Philadelphia, we endeavor to fix our location at the earliest possible moment by supplying sleeves to the building, to be placed in the foundation walls during the construction. These sleeves are nothing more than stove pipe cut about fifteen inches long. A couple of visits of the service foreman, who directs the mason on the job, just what depth to place sleeves, generally brings the desired results. The builder is pleased because it means his wall will not be broken by the installation of the gas service, and the gas company is benefited because it means much saving of time in the installation of the service. It is surprising how kindly most builders take to this scheme, and they really act as sentinels preventing

the use of this sleeve by the plumber, electric company or any other person desiring an easy way of supplying their service to the house. The gas service, in the majority of cases, is laid to new houses during erection, and it is generally found that the water and sewer connections are laid about the same time. The water trench is about one foot and the sewer trench four feet or more, deeper than the gas service, so if the latter is close enough to be affected by the later settlement of these two trenches, both of them carelessly back-filled, there is danger of a trapped or broken service. Again, if the service is in the trench of either water or sewer, it may be damaged at the time of any opening for their repair; therefore, as a rule, it is much better to isolate your service, wherever possible. Of course, there are many cases where it is impossible. Where a great amount of rock exists, laying in a sewer trench is worth considering. Often, after blasting has been done, and sewer connections made, there will be plenty of opportunity to support the gas service in the same trench. Blocking, resting on rock, with the service at the proper depth, or small pieces of pipe driven into crevices in the side of the trench and service laid on same, will often answer the purpose. However, it more frequently occurs that the water trench and the service ditch come together. In Philadelphia, the relative depths of the gas and water supply is about the same. In these cases, the gas service is laid on one side and the water on the opposite side of the trench, which allows about fifteen inches between the two. Repairs to either service could be made without much, if any, damage to the other.

Depth.—The standard depth of a service is fixed, of course, by the standard depth of the main. Taking 3 ft. 0 in. as the standard cover of a main with the service connection tapped into the top of the main, the service will have about 2 ft. 10 in. cover at this point. With this as a standard, the service should be so sloped that its cover would be about 2 ft. 6 in. just outside the curb, having a minimum of about 2 ft. 2 in. under the footway. The above depths are figured considering the main on the same side of the street. With the main on the opposite

side of the street, the service should have, at least, 2 ft. 0 in. cover just outside the curb, and 18 in. under the footway. It is often the case, however, that services have less depth than the above figures, but a hard and fast rule should be made never to allow (except in very special cases) a smaller minimum depth than 15 in. Where 1¼ in. services are used, practically the only disadvantage to shallow depths is the question of temperature. Of course, traffic strains must be considered also, the element of crushed or broken services being an important point. If the service is less than 2 ft. 0 in. deep, it is quite probable that in cold weather its temperature is several degrees less than that in the mains, and, therefore, the gas loses some candle-power in passing through it. Should the meter set in a cold place, it would then be advantageous to have a cold service thus preventing condensation forming on the diaphragm of the meter. We feel, in Philadelphia, that very few 1¼ in. services would be closed by frost if even laid shallower than the minimum 15 in.; of course, the climate in this section of the country is mild compared with that of other sections.

The reason why our services are kept deep is that the prevalent form of footway paving is artificial cement with cinder base, and it is essential for the long life of a service to keep it out of, and at a good distance from, cinders. It also appears to be the practice, of late years, to put down a concrete base for all roadway paving. As a rule, specifications for paving will read as follows:

Asphalt.	Inches
Asphalt	4
Concrete	9
Granite Block.	
Blocks	6 x 6 x 12
Sand	2
Concrete	6
Gravel base	6 to 8
Vitrified Brick.	
Size	9 x 3 x 5
Sand	2
Cement	6
Gravel base	6 to 8

CEMENT FOOTWAY.

Excavation	18 to 20
Cement top	1
Concrete (1-3-5)	3
Cinder or broken brick	14

Most paving contractors, before mixing their concrete, have heavy steam rollers run over the ground before the concrete is laid, to form the bed, and in Philadelphia, we have had many cases where services have been broken even at the depth I have given as our standard.

Service Drips.—There are times when it is impossible to grade the service back to the main and in such cases a service drip must be installed. One of two locations can be used, inside the house at head of service or just outside the front foundation wall. Wherever possible, the drip should be placed outside the house as an inside location involves several conditions which should be avoided as much as possible. Handling condensation in a house produces bad effects and should only be resorted to as the last means. It may be, in some cases, you can disregard the small amount of condensation formed and do without the service drip, but such cases are rather few in number.

It often happens that there is an obstruction somewhere between the main and the house, such as a duct, so in order to avoid service drip, the structure should be encircled with pipe as shown in Fig. 1. This installation is called the saddling of a structure. The sketch very clearly explains the condition.

Fig. 2 shows the two styles of service drips that have given us complete satisfaction. These sketches are also self-explanatory, so I will not endeavor to go into details. The drip box used for the outside drips would be the same as that employed for main drips.

Valve and Stop Cocks.—I believe that except where required by law, the general practice throughout the country is not to install curb cocks on services less than 2 in. The curb cock has several points in its favor, such as allowing a little more leeway for carelessness in meter work without causing much damage, also affords an opportunity of shutting off gas from a

burning building, especially when it is impossible to get at the meter, or the service has been broken by something heavy falling on the head of same. In case of delinquent consumers,

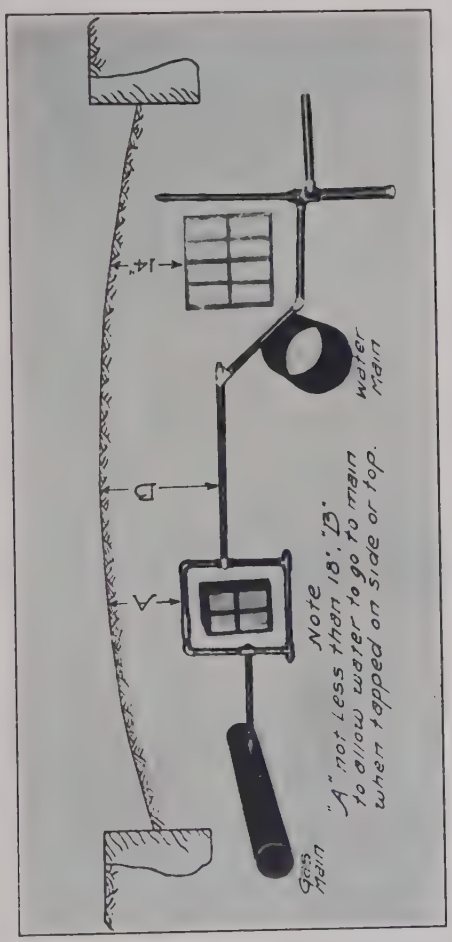


Fig. 1. – Method of encircling conduit by service and use of service drip.

it also allows the shutting off of gas without gaining entrance to the building.

Where service cocks are used, it is a safe estimate that it adds about 25 per cent. to the cost of the service with a small

percentage to maintenance, and it is questionable whether the good gained by this additional cost is justified. Many companies have satisfactorily adjusted their meter fitting practice

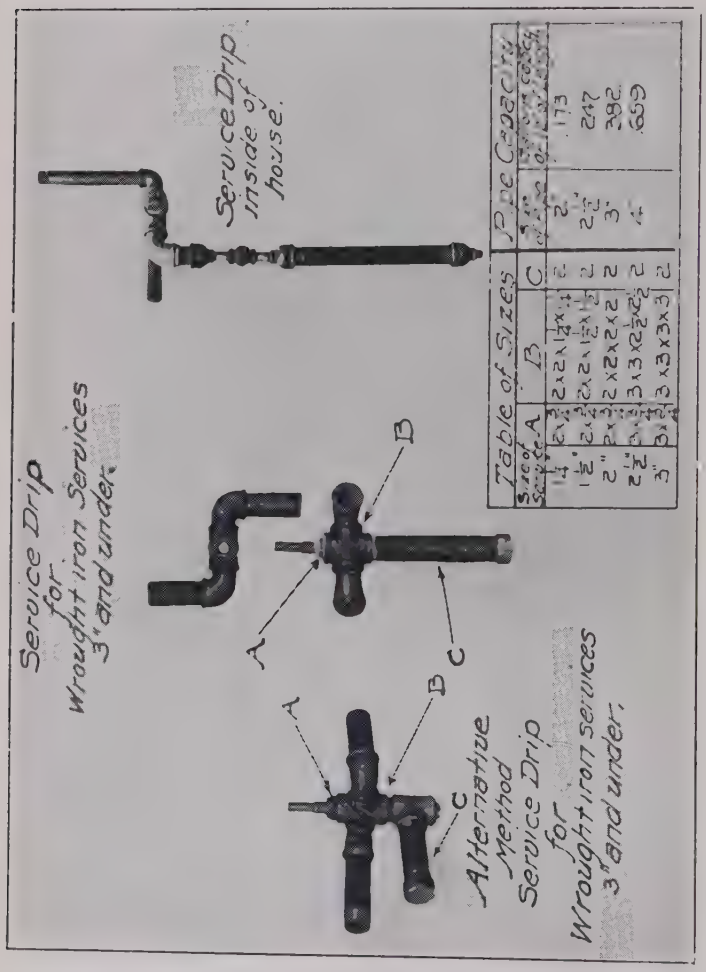


Fig. 2.—Service drips.

on the basis of no curb cock, and have encountered very little trouble.

Looking a little deeper into the advantages gained by the

curb cock, in case of fire, it generally means that if the meter is inaccessible, so is the curb cock, and if conditions do not permit of an immediate cutting off of the service at the main, the only result is the loss of a little gas with no effects on the spread of the fire. Generally the cellar will be flooded with water and if there is no curb cock, attention must be paid to drips in the vicinity to prevent the main from being shut off.

In the cases of delinquents, the cock can only be shut off where there is but one meter or consumer on the service. In large cities, the practice of having more than one consumer taking off a single service is becoming greater each day, so that, before many years, the advantage of having a curb cock for this purpose will be practically useless.

In Philadelphia, for services 2½ in. and larger, a valve is used instead of a cock. The main reason for such a decision is due to the great amount of trouble that has been encountered with the plug, in large cocks, sticking. It appears to be a rule that the larger the cock, the tighter the plug appears to *get,* and even after the most careful installation, there will be cases of sticking cocks which must be dug up to be turned or, after having been turned, develop a leak due to the extraordinary strain brought to bear to loosen the plug.

Material.

Wrought Iron and Steel.

Succeeding the old lead pipe of the early days of the gas industry, wrought iron pipe was used almost exclusively for service work, for many years. It was far superior to lead from the standpoint of rigidity, being less liable to trap, and then it was cheaper. In the early 90's, the steel industry began making steel pipe cheaper than wrought iron, and ever since that time, the use of wrought iron has been gradually falling off. The first impression of steel pipe gained by engineers was far from good; it had the reputation of being very uncertain as to temper and weld. Many claimed that great difficulty was experienced in cutting threads and that split pipe very frequently occurred. The general opinion of engineers that

steel pipe was markedly inferior to wrought iron in resistance of corrosion is one that has caused much discussion.

Year by year the steel industry perfected their product until the pipe became as soft as wrought iron with no more power needed to thread same than wrought iron. As to the question of the corrosion of steel pipe versus wrought iron, it is a feature that has been discussed by many prominent metallurgists of the country. The consensus of opinion seems to be that there is practically no difference between the two on this point. There have been many tests made both in laboratory and field. The United Gas Improvement Company have made many such tests. From laboratory experience, as far back as 1905, it was decided that there was little difference between wrought iron and steel in reference to corrosion; in fact, it was discovered that the new steel pipe appeared to have an outer coating of oxide which would resist corrosion far better than wrought iron. Many tests have been made of actual conditions in the field, and it has been the general opinion that both kinds of pipe showed almost the same loss of weight by corrosion, the tendency toward pitting being somewhat less in steel.

The steel industry has been developing a new process which, after several years time, has given many encouraging results. By this process the steel is treated mechanically, and does not in any way depend upon skilled labor beyond keeping up the machinery involved, hence uniform treatment is assumed.

This new process is a method of treating metal which consists in subjecting the heated bloom to the action of rolls having regularly shaped projections on their working surfaces, then subjecting the bloom, while still hot, to the action of smooth faced rolls and repeating the action whereby the surface of the metal is worked so as to produce a uniform dense texture better adapted to resist corrosion, especially in the form of pitting.

Summing up the comparison, I would say that the steel pipe had four points to its advantage, that would justify its use in preference to wrought iron, as follows:

(1) It costs much less.
(2) It is stronger and more ductile than wrought iron.
(3) It is more uniform in composition.
(4) The threads cut on steel pipe appear to be stronger.

Galvanized Pipe.

Galvanizing is simply a method of coating articles, usually of iron or steel, with zinc. Galvanized iron resists ordinary corroding agencies, the zinc becoming covered with a film of zinc carbonate, which protects the metal from further chemical action. If the work of galvanizing is done well, there is no doubt that this kind of pipe will resist corrosion far better than anything else that is being used at the present time, for service work. However, poor galvanizing is worse than none at all. If the coating of zinc does not adhere properly, corrosion takes place under the zinc coating.

Galvanized pipe has not been used as extensively as wrought iron or steel, due entirely to its high cost, but of recent years, you will notice, from the figures below, its cost has fallen to such an extent that it is just questionable now whether it would not pay to use it in preference to plain steel coated with some preservative. There is no doubt that the cutting of threads and the general handling of galvanized pipe could be done much cheaper than with coated steel, the coating always giving much annoyance, especially in clogging up dies, etc. While I have not experimented very extensively, I have done just enough to convince me that the additional cost of galvanizing pipe is saved in the labor cost of laying it, with certainly a much greater length of life than steel or wrought iron.

Comparison of Costs.

1¼ in. galvanized	1¼ in. wrought iron	1¼ in. steel (spellerized)	
0.061	0.0685	0.0437	
(including coupling)		0.006	Couplings per foot
		0.0038	Coating per foot
		0.0017	Additional handling due to coating
		0.0552	

Cast Iron.

On all installations requiring a service 4 in. or larger, cast iron pipe should be used. The slight additional cost over wrought iron or steel is easily accounted for in the life of the service. As I have stated before, in the treatise, many of these large services supply buildings with common risers where the floors are rented and, in this way, many large consumers take gas off one large service. The installation of these large services simply develops into a main condition, where certain practices are involved in connecting to existing mains. In Philadelphia, we have a schedule as follows:

SCHEDULE OF CONNECTIONS FOR SERVICES 4″ AND LARGER.

Size of new mains	Size of existing mains: 30 in.	24 in.	20 in.	16 in.	12 in.	8 in.	6 in.	4 in.	3 in.	2 in.
	Hat flange	Hat flange	Hub sleeve	Insert branch	Insert branch	Insert branch	Insert branch	Insert branch	Insert branch	Insert branch
4 in.	"	"	"	"	"	"	"	"	"	"
6 in.	"	"	"	"	"	"	"	"	"	"
8 in.	"	"	"	"	"					
	Insert branch	Insert branch	Insert branch							
12 in.	"	"	"	"	"					
16 in.	"	"	"	"						
20 in.	"	"	"							
24 in.	"	"								
30 in.	"									

The hat flange is used on all large mains where services do not run over 8 in., down to and including 20 in. In some cases a hub split sleeve is used on the 20 in., but in most cases, the lack of space requires the hat flange installation. With mains 16 in. and under, for services not larger than 8 in., a branch is generally inserted. Services that are 12 in. or over should always have a branch inserted regardless of the size of the main. Of course, there are many conditions that might affect the above ruling, and it will be necessary to install a hat flange. No matter what the connection may be it is always good practice, especially for services from 4 in. to 8 in., to make your connection at the main just a size larger than called for in the service. It is very easy to bush the outlet,

and if a larger service is ever necessary, you are prepared for same. It is remarkable how often just this condition occurs. Although you may install a service much larger than the consumption requires, you are amazed to hear that double or triple this consumption is necessary in probably less than a year.

Continuing the service from the main, cast iron should be run to within about three or four feet of the foundation wall, a bell piece being left at this point. From here on, through the foundation wall, a wrought iron or steel nipple should be laid having a screw thread on one end and a band about ½ in. wide and ¼ in. thick sweated on the other end to act as a bead. The joint between the cast iron and wrought iron or steel should be made with cast lead or, preferably, lead wool, as it is liable to receive some strains when the inside house connections are being made. A cement joint might be cracked. I will not describe these various main connections as they are very clearly outlined in Mr. Walton Forstall's paper on "The Installation of Cast Iron Street Mains." See Figs. 36, 37 and 38.

Preservative Coatings.

At the present time, there is no positive data giving the life of wrought iron or steel pipe, whether laid bare or coated, therefore, the practice of coating service pipe is not based on actual knowledge that its life will be lengthened. The coating cost is, however, so small as compared to the total cost of installation, that if only a small amount of life is gained for the service, the expenditure is justifiable.

There are many carbon and asphaltum paints on the market that are claimed to be just right for service work, but no real test has ever been made of them. You can see to make a thorough test would require years of time with many thousands of services involved. Certain paints would stand up well under certain conditions and be utterly useless under different conditions. Several tests have been made in Philadelphia, but only on a small scale, several lengths of pipe being

buried for a couple of years in bad soil or unfavorable conditions, and as yet there is no single paint that has proven more favorable than another. In 1887, The United Gas Improvement Company adopted the coating suggested to them by A. W. Hickenlooper, and have been using it ever since. The mixture is prepared as follows:

> Heat about 20 gals. of coal tar to a low boiling point and add 20 lbs. of fresh slaked lime sifted over the top and then worked down. Boil this mixture until it becomes pasty or tar like. Let it settle for a few minutes and then add 4 lbs. of tallow and 1 lb. of powdered rosin. Stir until thoroughly mixed and all ingredients dissolved, then allow to cool.
>
> When ready for use, to each bulk of 45 gals. of the above mixture add 4 lbs. of crude rubber dissolved in turpentine to the consistency of thick cream. Then heat the mixture to about 100° F. and immerse the service pipe, heated to about the same temperature, into same. The mixture should not be raised to a higher temperature than 100° F. Should the preparation be too thick, it can be thinned down with kerosene when being heated for use. It often occurs that when first preparing the mixture, the tar is boiled too long, causing it to become too thick.

Fig 3 shows the design of tank for mixing coating. This mixture can be applied with a brush after heating the pipe by steam or a trough can be constructed with a 1 in. steam pipe running along the bottom, inside, into which the pipe is dropped. The latter method is preferable where large quantities of pipe are to be coated and is the method employed, in Philadelphia, where the arrangements for dripping consists of a box 21 in. wide, 24 in. high and 22 ft. long, in which the pipe is heated by steam, 8 lines of 1 in. pipe being laid in the bottom for this purpose and connected by return bends. This box is elevated so that the bottom is level with the top of the dipping trough and about 9 inches from the trough

Fig. 3.—Design of tanks for mixing preservative coating.

a sloping board is placed provided with 3 2-in. hook plates screwed on perpendicularly. Six lengths of pipe are dipped, placed on these hooks and allowed to drain a few minutes before piling, the pipe being turned over two or three times to insure an even distribution of the coating.

The pipe is first thoroughly cleaned with coal ashes, all signs of rust or scale being cleaned off. Wooden caps are used to cap the ends while dipping. All pipe is very carefully gone over for defects, such as poor welds, etc., before being used.

It requires from 4 to 8 weeks, according to weather conditions, for this mixture to thoroughly dry so that a sufficient stock should always be kept to prevent the use of any lengths with coating not entirely dry.

On the basis of about half a million feet of 1¼ in. pipe per year, Philadelphia has been able to bring the labor cost of doing this work down to 0.1 cent per foot and 0.2 cent per foot for material. This includes cleaning, inspecting and coating. When the extra hauling is added to the above items, it brings the total cost of coating pipe to about 0.5 cent per foot. I mention this fact as I am informed that steel can be bought coated, for 0.5 cent per foot additional cost. Figs. 4 and 5 shows the pipe coating device used by The United Gas Improvement Company, in Philadelphia.

In 1903, an investigation was made of some 30 coated services that had been underground for 5 years in good soil. The coating was practically gone, only the slightest traces being left. There was, however, no signs of corrosion the pipe being as good as new. Another inspection was made in 1908 of some 40 services laid in 1898, 20 of which were coated; there was a very slight sign of corrosion on 8 of these coated services. The others, on which corrosion had not yet started, showed almost no trace of coating.

In 1913, an inspection was made of some 20 services of spellerized steel, laid in 1906. On all but 4 of these services there was a tracing of the coating.

Fig. 4.—Side view of pipe-coating trough.

Fig. 5.—Front view of pipe-coating trough.

These investigations have led to the belief that in good soil, coated service pipe may be expected to last, at least, from 20 to 30 years and, perhaps, much longer. After some 30 or 40 years, some valuable information will be obtainable in Philadelphia as a complete record has been kept of all services installed since 1897.

When bad ground is encountered, it is unwise to depend on coating alone for protection to the pipe. The service should be surrounded by a box or trough, preferably V-shaped, and same filled with cement or pitch. Of course, this increases the cost of the service installation considerably, but when it is considered that many services will last but a year in bad soil, it can be easily seen that your first cost, although high, saves money in the end. Galvanized pipe can also be used in many of these places where the soil conditions are bad.

Valves and Stop Cocks.

The cocks used on services 2 in. and smaller should be made of brass and of the ordinary plug cock type. There are several types of this kind of cock manufactured at the present time that are quite satisfactory for this work. However, a large company should decide upon its own design and metal composition to suit conditions. It is essential that the cocks be inspected at the place of the manufacturer where the proper knowledge can be obtained as to the character of the grinding and greasing. Neglecting the precaution of inspection will cause considerable annoyance from leaking and even broken cocks.

A valve should be used for services 2½ in. and larger. In Philadelphia, the ordinary double gate valve is used. As I have stated before in the paper, the constant sticking of cocks larger than 2 in. makes it almost compulsory to use valves. The cost of a valve is practically the same as a cock of corresponding size, therefore, much is to be gained in using the former. Where it is the policy to use both stop cocks and valves, it is necessary to, in some way, designate the same on the stop box. A very simple way would be to have the letter

"V" cast in large size on the stop box cover, which would indicate a valve on service. Those box lids not having this letter on, would, of course, indicate stop cocks.

The type of cocks and valves used in Philadelphia is shown in Fig. 6. Instead of the usual square head, the valve is fitted with a rectangular head. This change was made in order that a stop key used for plug cocks would answer for the valves.

Stop Boxes.

A stop box should be made in two pieces in order that the length can be easily adjusted. It is also essential that it have a broad base in order that it will not readily shift its position either by settling or tipping over. The bell should be so designed that it will allow ample room to clean dirt from around the cock. Oftentimes, these boxes become filled with dirt which has worked its way through the opening in the side of the bell left for the service pipe, or with other foreign substances thrown in by malicious children.

The weight of the lid is also an important feature. It should be made quite strong in order to resist severe blows. Fig. 6 shows the type used in Philadelphia on all service work, footway and roadway locations as well as on drip work.

Blocks.

The proper blocking of a service is very essential for the long life of a service. In Philadelphia, the standard size block measures 8 in. x 8 in. x 1 in. It has been found that an untreated block holds enough moisture, especially in clay soil, to produce a marked increase in corrosion at the point of contact with the service pipe; consequently, it has been decided that creosoted blocks are better suited for the purpose. As to the details of blocking, I will speak of this later on, in the paper.

Tools.

The tools and accessories in a well-equipped service barrow may be readily divided into five groups, namely, those used for trenching and refilling, laying, maintenance, leak work

Fig. 6. — Long and short stop boxes, extension piece and lids, valve and stop cocks.

and those of a miscellaneous nature, which may be used to advantage in all parts of service work.

Trenching and Refilling.

(A) 4 Asphalt cutters.
(B) 2 Asphalt wedges.
(C) 3 Picks.
(D) 4 Pick handles.
(E) 2 Rammers.
(F) 3 Round nose shovels.
(G) 2 12 lb. sledges.
(H) 1 Stone bar.
(I) 1 Tunnelling bar.
(J) 1 Tunnelling shovel.
(K) 1 Driving point.
(L) 1 Search bar.
(M) 2 Rock wedges.
(N) 2 Frost wedges.

In service work, the roadway opening is usually small, making a large supply of asphalt cutters and wedges unnecessary. The asphalt cutters, A, Fig. 7, weigh about 12 lbs. each and are made of medium soft steel with about 6 in. of good steel spliced to the end of each arm. These steel ends are drawn out with a fairly sharp cutting edge from 2½ in. to 3 in. wide, which is tempered so as to be hard and tough. The metal back of the cutting edge is rather thick which partially prevents pieces of steel from breaking out of the cutting edge. The asphalt cutters are provided with an eye, which should fit an ordinary pick handle.

The asphalt wedge, B, Fig. 7, is used in lifting the asphalt in large pieces after the cutting. It is made of a good grade of steel and tempered so as to be both hard and tough.

The picks, C, Fig. 7, are of the familiar railroad pattern, weighing 8 or 9 lbs., while the shovels, F, Fig. 7, are the regular sharp nose, hollow-back, "D" handle, lifting about 15 lbs.

A shovel, useful in trenching through sod and in ordinary tunnelling, is shown in J, Fig. 7. It is known as a tunnelling

spade and is a flat nose, plain back shovel, about 7 in. wide, with a straight handle.

For removing other kinds of paving such as brick and granite block, the stone bar, H, Fig. 7, is used extensively. For breaking down the concrete bases and wedging out frozen earth, 12 lb. sledges, G, Fig. 7, and rock or frost wedges, M and N, Fig. 7, are used. The rock and frost wedges are made

Fig. 7.—Trenching and refilling tools.
(A) Asphalt cutter. (B) Asphalt wedge. (C) Pick. (D) Pick handle. (E) Rammer. (F) Round nose shovel. (G) 12-lb. sledge hammer. (H) Stone bar. (I) Tunnelling bar. (J) Tunnelling shovel. (K) Driving point. (L) Search bar. (M) Rock wedge. (N) Frost wedge.

of tempered steel and are similar in most respects, the frost wedge being longer and having a rounded cutting edge while the rock wedge has a straight edge. The search bar, L, Fig. 7, is also used for this purpose. It consists of a heavy hexagonal bar about 1½ in. in diameter, ranging from 18 to 24 in. long, being tapered at one end.

The tunnelling bar, I, Fig. 7, is used for tunnelling under the footway or roadway, where, for any reason, an open trench is undesirable. It is made of solid steel with one end drawn out to a blade about 2½ in. wide and tempered. This bar is also found useful in hard or frozen ground. The rammers, E, Fig. 7, used in back-filling, are bell shaped iron casting with a face about 6 in. in diameter and provided with either a wooden or wrought iron handle. Driving points, K, Fig. 7, are pieces of round steel about 1 ft. in length, drawn out at one end to a long sharp point and having a male thread on the other. These points come in various sizes and are attached to the service pipe, so that it may be driven under expensive paving.

Laying.

For steel services, the following tools are used:

(A) 1 Bench vise.
(B) 1 Tapping machine complete (including wrenches to set up machine).
(C) 1 Set of rubber saddles for tapping machine.
(D) 1 Extra long chain.
(E) 1 Set combination drill and taps—¾ in. to 2 in.
(F) 1 Reamer—¾ in. to 1 in.
(G) 1 Reamer—1¼ in. to 2 in.
(H) 1 Solid stock for dies—¾ in. to 2 in.
(I) 1 Set of dies for stock.
(J) 1 Wood chisel.
(K) 2 12 in. wall chisels.
(L) 1 10 in. pipe wrench.
(M) 1 14 in. pipe wrench.
(N) 2 18 in. pipe wrenches.
(O) 2 24 in. pipe wrenches.
(P) 1 14 in. monkey wrench.
(Q) 1 Set rubber plugs with handle—¾ in. to 2 in.
(R) 1 Roller pipe cutter—¾ in. to 2 in.
(S) 1 3 in. wheel pipe cutter—¾ in. to 2 in.
(T) 1 24 in. spirit level.
(U) 1 Stock and dies—1¼ in. to 2 in.

For services, it is often necessary to tap a main with the gas on. For this purpose, the combination drilling and tapping machine, B_1 and B_2, Fig. 8, is used. This machine drills, reams and taps a hole in one operation, and, at the same time, prevents the escape of gas.

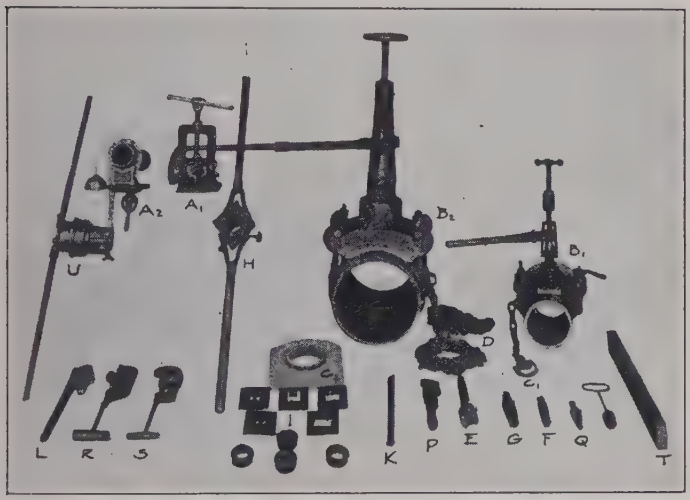


Fig. 8.—(A_1) Bench vise. (A_2) Bench chain vise. (B_1) Bench tapping machine (small) ¾ in. to 2 in. (B_2) Bench tapping machine (large) 2½ in. to 4 in. (C_1) Rubber saddle for small machine. (C_2) Rubber saddle for large machine. (D) Extra long chains for large pipe. (E) Combination drill and tap. (F) Reamer—¾ in. to 1 in. (G) Reamer—1¼ in. to 2 in. (H) Solid stock for dies—¾ in. to 2 in. (I) Set of dies for solid stock. (K) Wall chisel. (L) Trimo wrench. (P) Monkey wrench. (Q) Rubber plugs. (R) Roller pipe cutter. (S) 3 in. wheel pipe cutter. (T) 24 in. spirit level. (U) Stock and die.

The vise attached to the cart is a hinged malleable iron pipe vise with removable jaws and few parts. It is bolted to the cart and will accommodate most sizes of pipe up to 4 in. The wrenches are drop forged from steel and have as few parts as possible, with all parts interchangeable. The stock and dies should be strong, but not too heavy, and the stock should allow

for easy changing of the dies. While several size stocks are made, one solid stock to accommodate ¾ in. to 2 in. will usually be sufficient.

I have found that the great trouble in threading pipe is due to the use of dies which are inadequate to perform, properly, their expected work. To secure a pipe die that will work equally well on different kinds of pipe, several features must be harmoniously combined, namely, the "clearance," the "lead," the "rake" and the "chip space." Just recently a die has been placed on the market with two additional features, the "spiral chaser" and the "rounded bottom skip tooth," that, in my estimation, are exceptionally good and decided improvements over the old style die. Taking the above features in the order named, we have:

(1) *The Clearance.*

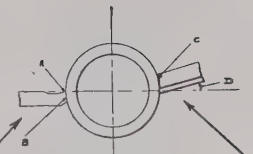
In most dies, very little attention has been paid to this point, causing the die so made to be very hard to use. The new dies are so tapped that the proper clearance is left on each chaser. The die that has too much clearance will usually break. I have found that the clearance for each size of die should be different, also that the clearance should be circular.

(2) *The Lead.*

The lead is the angle on the front of each chaser, which enables the die to start on the pipe and also distribute the first cut over a number of threads. In a series of experiments, I found that the lead was found to change with each size of pipe, and as the heaviest cutting is done by the lead, I found that the clearance of the teeth should be greater than in the rest of the die, Fig. 9. The lead in the new die covers about three threads, and has proven to be sufficient for all the work we have done.

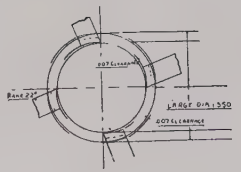
(3) *The Rake.*

The rake is the inclination of the cutting edge of the

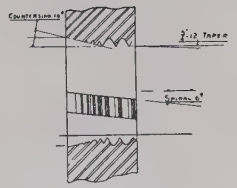


Chaser milled to obtain rake will break easily

Straight chaser inclined to the work at proper angle, as used in the new die This chaser is very strong



End view, of the new die showing clearance, and rake of chasers



Sectional view of new die showing countersink, spiral chaser, and rounded strip tooth.

Fig. 9.

chaser to the surface of the pipe, and is one of the most important features in a well-constructed die, and is also one of the hardest features to get absolutely cor-

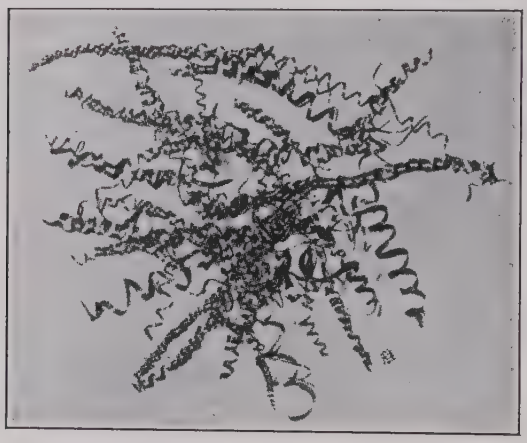


Fig. 10.—Chips thrown off by a properly designed die.

Fig. 11.—Chips thrown off by a die of ordinary design.

rect. Many manufacturers attempt to get a rake by milling or rounding the cutting face of the chaser, as shown in the cut, but in the new die, the rake is obtained

by inclining the chaser to the work at the proper angle.

Where the rake is obtained by milling the cutting face of the chaser, it is made dangerously weak and is very liable to breakage. Inclining the chaser to the proper angle, as in the new die, insures for greater strength and a much better cutting tooth.

In cutting pipe with a pipe die, the same condition prevails as with a lathe tool—the best results are obtained only by cutting the metal out smooth. This will result in long curling continuous ribbons of metal. If the metal is removed in small chips or chunks, the operator of the lathe tool immediately knows that he has not set his tool at the right angle. The chips produced by the ordinary die are simply small crumbs of metal, whereas the chips produced by the improved new die are long, curling ribbons of metal. Photographs 10 and 11 show the proper and improper character of chips thrown off by chasers.

(4) *The Chip Space.*

This is the space that should be required in the holder in front of the chaser, to allow room for the accumulation of chips. Without this space, the chips are liable to clog and tear the threads.

(5) *The Spiral Chaser.*

In the new die, the "chaser" is placed "spiral to its axis," thereby gaining an additional rake which increases the efficiency 100 per cent. without impairing its strength.

(6) *The Skip Tooth Feature.*

The last added and the most important improvement in the new die is the newly designed skip tooth feature. Previously, the teeth, which were removed to form the skip tooth feature, were cut out squarely at the base or the root line of the chaser, and some little difficulty was found in the breakage of the remaining teeth. It is uni-

versally known among tool makers that square corners must always be avoided in hardening or tempering tools, consequently, the manufacturer has rounded out the bottom of the skip tooth instead of leaving it square. These rounded bottoms are extended below the root line of the chaser and are exactly the same in construction as that adopted in all circular saws. They have gained two features by this improvement:

First: The adjacent teeth are much stronger than those in any other type of die, and, in fact, are stronger than the front teeth in the same die.

Second: This feature allows for greater clearance for the escapement of chips and oil than can possibly be found in any other construction.

I have been testing one of these new dies for three months, and from all appearances, it is as good as new after having cut about 1,100 1¼ in. threads. The construction of the die is such that its action in cutting acts the same as a lathe tool; however, the one very essential feature is that good lard or crude cottonseed oil be used in liberal quantities. The best die made will not produce good results with poor oil.

The adjustable stock and die is a very well thought of tool, especially in Philadelphia. It is readily adjusted to suit various sizes from 1 in. to 2 in., and can be easily operated by one man. If proper care is taken of this tool, it will last indefinitely.

For shutting off the gas from the service after the street tee has been inserted in the main, a rubber plug, with handle, is used. A set of these plugs are carried in sizes ¾ in. to 2 in., and by using these plugs, the service can be continued more rapidly and safely.

The roller pipe cutters for cutting pipe from ¾ in. to 2 in. are of the regular style in favor with most plumbers and steam fitters.

The wall bars are of hardened steel and of various lengths.

They are somewhat similar to a short tunnelling bar and are used for breaking through cellar walls for the services.

It is sometimes advisable to have a service gang extend the smaller mains for a short distance especially where a couple of new services are involved, instead of moving a main gang

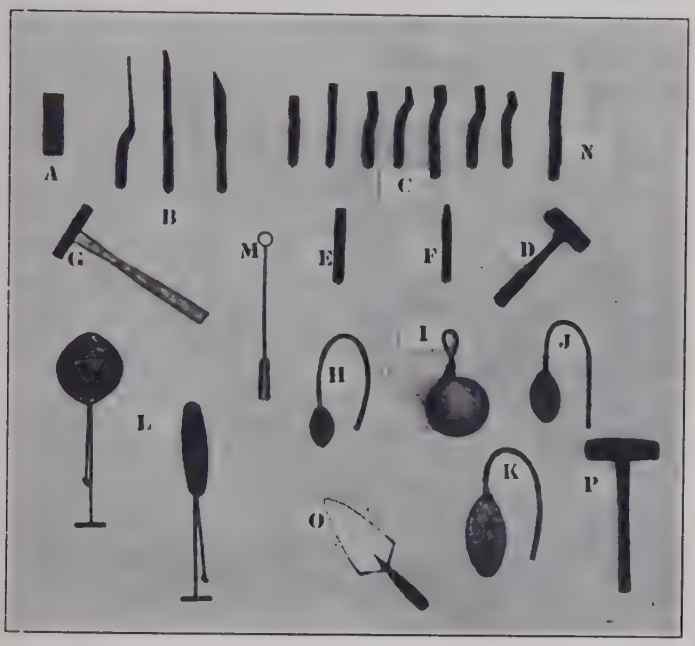


Fig. 12.—Main-laying tools carried by service cart.

(A) Bursting wedge. (B) Cape chisels. (C) Set caulking tools. (D) Caulking hammer. (E) Cold chisel. (F) Diamond point. (G) Dog chisel and handle. (H), (I), (J), (K) Rubber bags. (L) 6 in stoppers. (M) Bag fork. (N) Yarning iron. (O) Trowel. (P) 8 lb. striking hammer.

probably a long distance for such work. For this reason, the service cart carries an assortment of main laying tools as follows (see Fig. 12):

(A) 2 Bursting wedges.
(B) 2 Cape chisels.
(C) 1 Set caulking tools.
(D) 1 Caulking hammer.
(E) 3 Cold chisels.
(F) 4 Diamond points.
(G) 2 Dog chisels and handles.
(H) 2 2 in. Rubber bags.
(I) 3 3 in. Rubber bags.
(J) 2 4 in. Rubber bags.
(K) 2 6 in. Rubber bags.
(L) 3 6 in. stoppers.
(M) 1 Bag fork.
(N) 2 Yarning irons.
(O) 1 Trowel.
(P) 1 8 lb. Striking hammer.

The diamond points, F, Fig. 12, are used for gouging cast iron pipe and fittings. The head is carefully dressed and the point tempered. The bursting wedges, A, Fig. 12, are used in cracking pipe after it has been gouged. They are made of a good grade of steel, carefully dressed, but not tempered.

The cold chisels, E, Fig. 12, and cape chisels, B, Fig. 12, are the regular machinists' type with carefully dressed heads and tempered points. The cold chisels are used for chipping cast or wrought iron pipe and countless odd jobs about the cart. The cape chisels are used, principally, for cutting out lead or cement joints.

The yarning iron, N, Fig. 12, and set of caulking tools, C, Fig. 12, are the same as used in main work and can be used for either lead or cement. The caulking tools are tempered medium hard.

Maintenance.

Perhaps the most useful tools in maintenance work are the spoon bar, B, hammer, C, and chisel, A, Fig. 13. The hammer and chisel are used for cutting away cement when it is found that a stop box has been cemented over. The spoon bar is an

iron rod with a flattened end turned at right angles to the bar so as to form a spoon. It is used for cleaning the dirt from

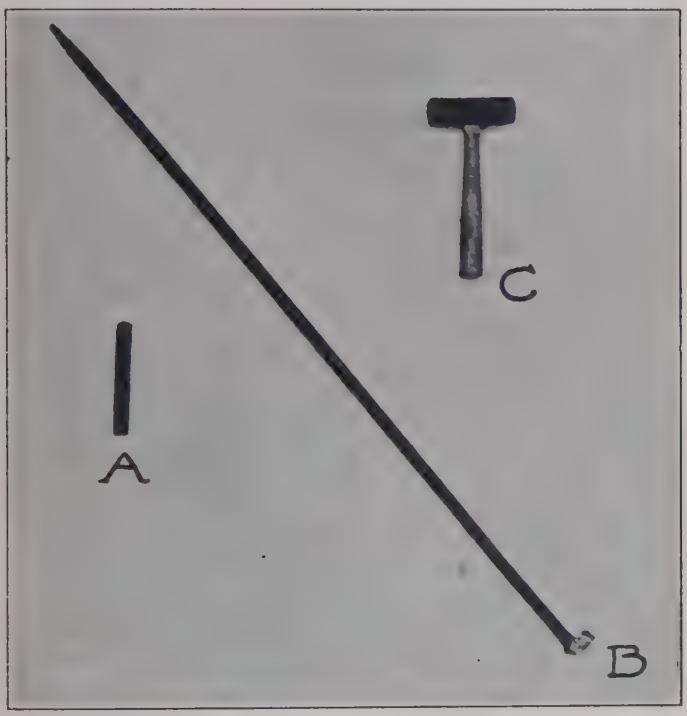


Fig. 13.—Maintenance tools.
(A) Cold chisel. (B) Spoon bar. (C) Hammer.

stop boxes, which will work into them in course of time. Other equipment used on maintenance will be described later.

Leak Work.

For leak work, the tools must be sufficient for almost any condition found, yet few enough to be carried by three or four men either walking or on trolley cars. A good set of leak tools consists of the following:

(A) 2 Sledges.
(B) 1 Search bar.
(C) 1 Stone bar.
(D) 2 Picks and shovels.
(E) 1 Smelling bar.
(F) 1 Stone bar.
(G) 4 Cakes of soft soap.
(H) 1 Electric torch (hand).
(I) 1 Asphyxiation kit (pocket edition).
(J) Tallowed muslin.
(K) 1 Caulking hammer.
(L) 1 Cold chisel.
(M) 1 Trowel.
(N) 1 Set caulking tools.

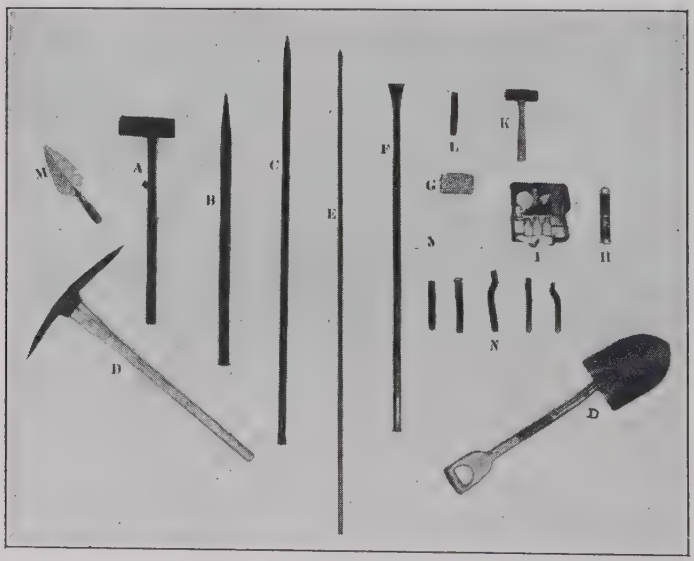


Fig. 14.—Leak work tools.
(A) Sledge. (B) Search bar. (C) Stone bar. (D) Pick and shovel. (E) Smelling bar. (F) Stone bar. (G) Cake of soap. (H) Electric hand torch. (I) Asphyxiation kit (pocket edition). (J) Tallowed muslin. (K) Caulking hammer. (L) Cold chisel. (M) Trowel. (N) Set caulking tools.

The smelling bar, E, Fig. 14, is a piece of ⅜ in. pipe closed at one end and small holes drilled at intervals of about 4 in. for a short distance from the closed end. After a hole is driven over the suspected location of a leak, the smelling bar or pipe is inserted in the hole to better locate the odors of gas.

The soap and tallowed muslin are used for stopping the leak until permanent repairs can be made.

The electric torch is used mainly for examining gaseous cellars which are often very dark.

Miscellaneous.

In this group are many tools and articles so common to the average layman as to need no description, yet are found absolutely necessary on many occasions. In this group, too, are found many tools useful in all branches of service work; they are as follows:

1 Asphyxiation kit.
4 Danger flags.
6 Danger lamps.
1 File.
1 Galvanized bucket.
1 Galvanized stationery box.
1 Lamp post ladder.
1 10-in. Screw driver.
1 Soap brush.
2 Solid wrenches for split sleeves.
1 Stop key.
1 Tar brush.
1 Trowel.
2 3-in. Wooden plugs.
2 4-in. Wooden plugs.
2 6-in. Wooden plugs.
1 pr. Bar tongs.
1 Compass saw.
1 Dope brush.
1 Dope can.
1 Hatchet.

1 10-in. Level.
1 pr. 12-in. Gas pliers.
1 qt. Machine oil in can.
1 gal. Coal oil in can.
1 Squirt oil can.
1 Sponge.
1 25-ft. Tape line.
1 2-gal. tar can.
1 Brick hammer.
1 "U" gauge.
25 ft. Service wire.
1 Orifice test cap and box.

The bar tongs are the ordinary type similar to blacksmith's tongs. They are used for holding the bars while they are being struck by the sledge.

A good form of danger flag is one with a curled top to the rod, giving a firm support for a lantern as well as making it harder for a person to remove or steal the lantern, Fig. 20. The galvanized iron stationery box is filled with the various forms and stationery used by the service men and affords a very good means of keeping them clean.

Equipment.

Miscellaneous.

Under this heading, I have included certain equipment that would not come under the heading of "Tools." Many of these articles are used on leak work, but I have not sub-divided in this portion of the paper, as I will speak more of their use later on.

Electric Lamp.—For night leak work, it is almost always necessary to have a fairly strong light of some kind to lower into the ditch. Of course, a naked flame would be very dangerous and must never be used. There are a great many electric lamps in the market, varying in price, that answer the purpose, but in Philadelphia, after trying out various types of wet and dry cells of different kinds, we have found that we

Fig. 15.—(A) Respirator. (B) Electric lamp. (C) Rainy day clothing. (D) Hand tools. (E) Lawn canvas. (F) Boots with leather soles.

get about as good results (for less money) by using a dry battery equipment that we make up ourselves. It consists of 6 cells with a total of 8 volts and 20 amperes and gives a light of about 6 candle-power. This equipment will last about 14 hours of continuous running. In order that these batteries do not fail when needed, a chart is kept on the inside of the lid, the man using battery being compelled to put down just how many hours it was running when he had it out, so that the next man using it can tell how long it may be expected to last, or the foreman inspecting boxes can tell when a renewal of cells is necessary. B, Fig. 15, shows the equipment as well as the record on the inside of lid.

Electric Hand Torch.—As D, Fig. 15, shows, this torch is a small affair that will slide into the pocket very easily and is of great assistance in dark cellars, manholes and on leaks, etc. The dry battery will last for 10 hours continuous running or 20 hours of intermittent using. The cost of the entire outfit is only $1.05 while the batteries cost 19 cents each. The small tungsten bulbs last about 40 hours and cost 20 cents each.

Respirator.—There are many cases where a man is compelled to work in a gaseous atmosphere for some time, both in main and service work. To provide for such cases, a respirator was designed that has been in use in Philadelphia for several years and gives entire satisfaction. It is only a small affair measuring 1 ft. x 1 ft. x 2 ft. and can easily be carried by one man. The photograph, A, Fig. 15, gives a good idea of just how it should be used. In design it is simply a bellows worked by foot power, that supplies air to a mouth-piece similar to that used by dentists. This mouth-piece is so arranged that it can be easily strapped on the head and causes very little annoyance to the wearer. A belt attached to the hose is strapped around the waist. This keeps the hose out of the man's way, and he is able to work indefinitely in a gaseous atmosphere. These respirators are easily made at a small cost. Below, I have given a list of material needed and its cost:

Material:		
25 feet of rubber hose, ½"	$4.00	
6 feet of flexible tubing, ¼"	.54	
2 feet of flexible tubing, ⅜"	.26	
Bellows	4.55	
2 handles	.10	
Galvanized iron	.50	
1 square foot of screen	.20	
8 pounds tire steel	.50	
Straps for head gear	1.00	
Mouth piece	1.25	
Belt	.50	$13.40
Labor:		
Making respirator		6.00
Total cost		$19.40

Asphyxiation Kits.—Asphyxiation kits contain supplies to aid persons who are affected or overcome by gas, and should be carried by every service cart. In Philadelphia, two kinds of kits are supplied, one in the form of a tin box and the other in a leather case. The tin box is substantially constructed, measuring 8½ in. x 9 in. x 4 in. with a tight-fitting hinged lid and catch, and wire handle. It is enameled inside and out to prevent rusting. This box is carried on the wagons and carts or any place where the contents need protection against severe blows of any nature. The leather case does not contain as many articles as the tin box, due to its size, measuring 8 in. x 4 in. x 1½ in., and was made up for the use of complaint men on leak work, as the package is small and can easily be carried in a side pocket.

The following shows the contents of the kits (see Fig. 16):

Tin Box.

Medicine:

*1 bottle Aromatic spirits of ammonia.
1 bottle Phenol sodique.
*6 bottles Effervescing sodium phosphate.
2 boxes Vaporole ammonia capsules.

* These are the only remedies that may be taken internally.

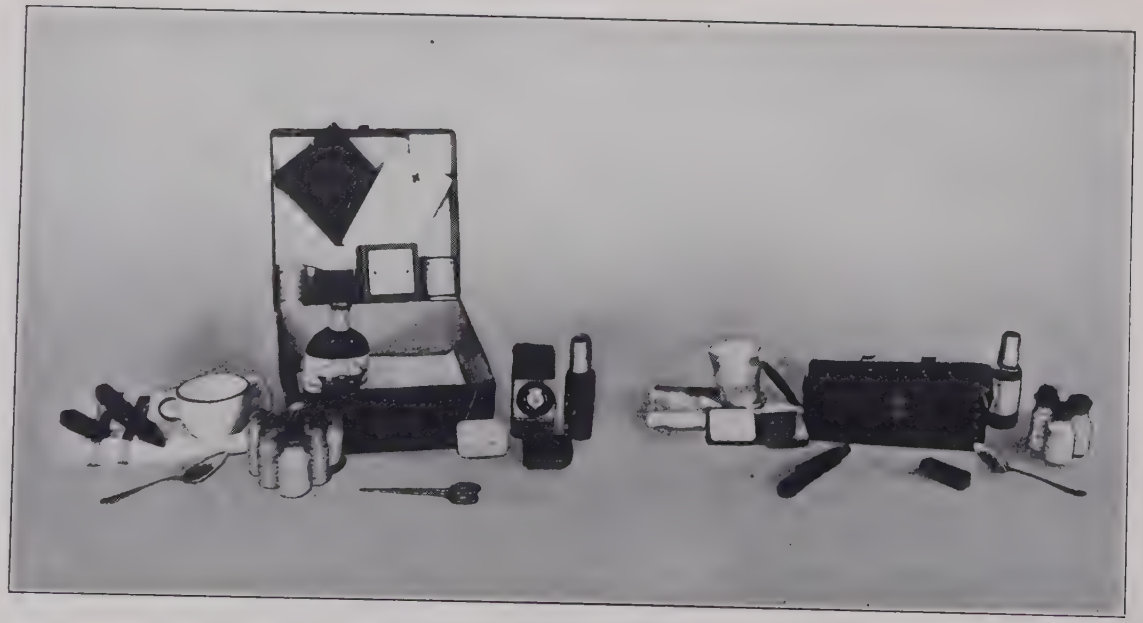


Fig. 16.—Two styles of asphyxiation kits.

Dressings:

1 1 oz. pkg. Absorbent cotton.
1 roll 1 in. Adhesive tape.
1 roll 2 in. Cotton bandage.
1 roll 2 in. Gauze bandage.

Utensils:

1 Jaw block.
1 pr. Scissors.
1 pr. Tongue pliers.
1 Teaspoon.
1 Folding tin cup.
1 Tourniquet.
2 Towels.
2 Books of Instruction:
1st: First Aid to Persons Overcome by Gas.
2nd: Treatment for Cuts and Abrasions.

Leather Case.

1 bottle Aromatic spirits of ammonia.
4 bottles Effervescing sodium phosphate.
2 boxes Vaporole ammonia capsules.
1 Folding tin cup.
1 Teaspoon.
1 pr. Tongue pliers.
1 Jaw block.
1 Book of Instruction:
First Aid to Persons Overcome by Gas.

All men on service work should be perfectly familiar with the uses of the various articles in these kits and the treatments given in both books of instructions should constantly be rehearsed by them. Periodical meetings should be held for this purpose.

Recording Gauges.—Recording gauges are used for the continuous recording of pressures through certain periods. This gauge consists of a clock mechanism which revolves a chart upon which is traced a line by a pen point. The pen point is

at the end of an arm which is attached to a sensitive mechanism upon which the changes in pressure act, and this causes a movement of the arm and pen point. In service work, gauges of this nature are very important, being put on the head of services to ascertain the existence of fluctuations, stoppages and excessive or low pressures.

In deciding between various types of recording gauges, they should be tested for accuracy, sensitivity and constancy. ease of adjustment and of regulation and operation.

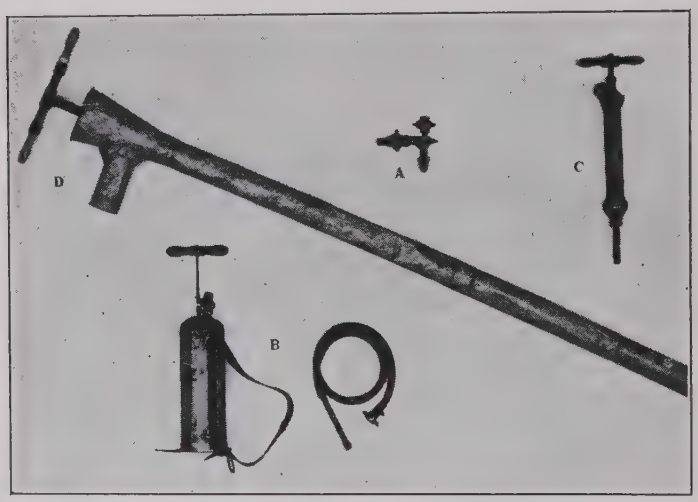


Fig. 17.—(A) Safety device used in pumping services. (B) Force pump. (C) Drip pump. (D) Cellar pump.

Safety Device Used in Pumping Services.—This device, A, Fig. 17, is constructed for use in clearing obstructed services that have been in use for many years. The idea of its design is to allow a man to wire and pump a service without permitting the escape of much gas. It is constructed for use on ¾ in. services, but can easily be made to suit any size.

The ¾ in. plug is removed from the head of the service, the nipple and cock portion of device being installed with the cock

off. The union portion of cock is then attached to the device. To wire the service, remove the ⅛ in. plug, insert wire, turn on ¾ in. cock, then push wire through to clear service. After pulling the wire out, shut off ¾ in. cock. If service is not clear, insert plug, open ¾ in. x ½ in. cocks and fill service with alcohol; shut off both cocks. Remove ¾ in. plug and put on drip pump. When finished pumping, open ½ in. cock and repeat the same operation several times. Following this practice, many services have been cleared of rust, with the operator getting very little gas.

Force Pump.—This device, B, Fig. 17, is simply the ordinary type of hand air pump with the storage tank attachment. It is used in blowing out obstructions in services, lamp risers, etc. The very convenient form shown and used in Philadelphia consists of a light cylindrical brass tank 18 in. long and 6 in. in diameter, with an ordinary hand air pump mounted at one end, having a 1½ in. cylinder about 12 in. long. The body of the pump is in the tank and the outlet has a check to prevent the compressed air escaping back through the pump. At the outlet of the tank is placed a ¾ in. lever handled union cock to which is attached about 6 ft. of ¾ in. heavy rubber hose. A strap is attached to the tank in order that the pump can be easily carried over the shoulder.

Drip Pump.—A drip pump, C, Fig. 17, is used for extracting water from gas drips and clearing services. It is of the suction type and should be of substantial construction, being made of brass. A pump with about 2¼ in. diameter cylinder, 12 in. stroke and with the suction fitted for ¾ in. wrought iron pipe, is best suited for general work.

Cellar Pump.—The cellar pump is used in emptying cellars of water. The photograph of same is self-explanatory, D, Fig. 17.

Stop Cock and Valve Keys.—Small Stop Cock Key: This key, D, Fig. 18, is used for the general turning on and off of stop cocks from ¾ in to 2 in. The stem is made of ¾ in. round iron with a heavy piece of wrought iron welded to one

end with a slot ¾ in. wide and at the other end there is a 12 in. cross arm. One end of this cross arm is drawn out to a sharp point and the other to a sort of chisel point, ¾ in. wide. A key of this style should be made about 4 ft. long.

Large Stop Cock Key: This key, C, Fig. 18, is made much longer (6 ft. and over) and is used in turning stop cocks and valves which are very deep. It is made of 1 in. round iron with the cross bar measuring 20 in. and the slot 1¼ in. wide.

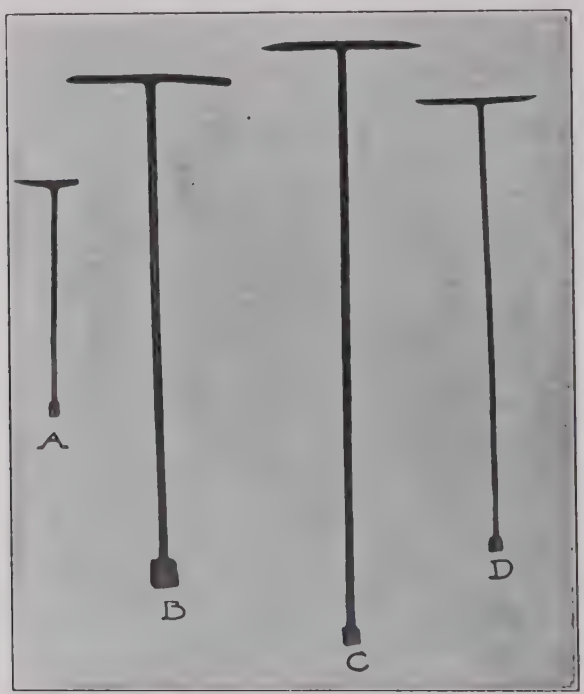


Fig. 18.—Stop cock and valve keys.
(A) Drip key. (B) Valve key. (C) Large stop-cock key. (D) Small stop cock key.

Valve Keys: These keys, B, Fig. 18, are like the large stop cock key except that instead of a slot there is a form which fits the square heads on the end of the street main valve stems.

Drip Keys.—The drip key, A, Fig. 18, is used in removing plugs from the top of drip rods. It is similar to the valve key, only much smaller, being made of ⅝ in. round iron. The key is 20 in. long with a hole in the end to fit the head of the plug.

Street Lamp Ladders.—These ladders are especially designed for lamp post work. They are made of a good lumber and are 9 ft. long, 12½ in. wide at the bottom and 10½ in. at the top. The rungs are made of hickory and are spaced 1 ft. apart. The side pieces are made of 2½ in. x 1 in. spruce-pine. At the third and fourth rungs from the top, an additional rung is strapped to the sides to give a better foot rest. Wrought iron spikes are placed at the bottom of the ladder, and at the top, wrought iron hooks which fit the iron ladder bar in lamp.

Lawn Canvas.—In trenching through lawns, it is necessary to be very careful not to disturb or injure flower beds or shrubbery, and to protect the grass as far as possible. Canvas spreads, E, Fig. 15, measuring 5 ft. x 20 ft. are made for this purpose and are laid over the grass and sewer vents so that the earth will not touch the grass or get into the sewer vent.

Rainy Day Clothing.—When the men are compelled to work outside under very wet conditions, oil-skins and rubber boots are supplied for this purpose, to the foreman and his gang, being returned to the shop when the conditions of the weather warrant it. When drawing out these garments from the store room, each man is charged with the suit loaned to him and must pay for it if not returned. We have found, in Philadelphia, that oil-skins answer the purpose as well as rubber clothes, with a much cheaper cost. An oil-skin, properly taken care of, will last a year and probably longer. C, Fig. 15.

The boots, F, Fig. 15, used in Philadelphia are the high hip kind with leather soles. Rubber soles do not last long when a man is compelled to dig. They are loaned under the same conditions as the oil-skins.

Tamping Machine.—The tamping machine, Fig. 19, is a single outfit that has given very successful results in the back-

filling of trenches, both for main and service work. In cases where work is done ahead of repaving, it is essential that the dirt be tamped properly or there is bound to be a complaint from the paving contractor. With hand tamping, you are compelled to depend entirely on the man as to the quality of the work done, and it is very often slighted. By using this machine, back-filling can be done for about 8 cents per cubic

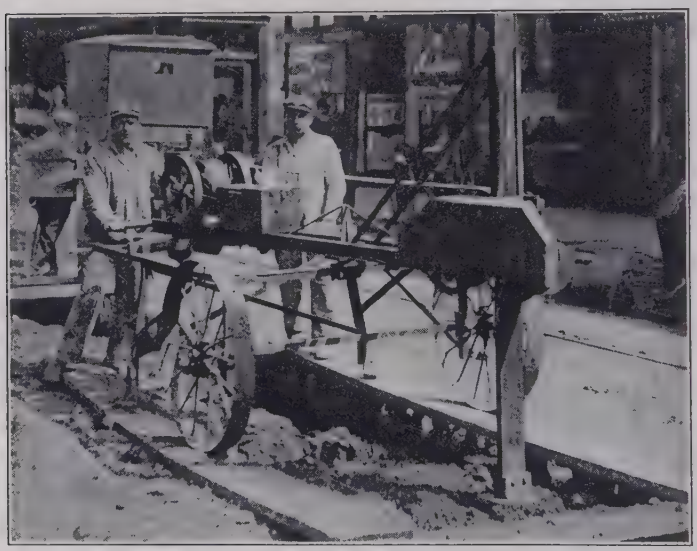


Fig. 19.—Power tamping machine.

yard, with a positive assurance that all the dirt goes back into the trench, consequently, a double saving over hand tamping as there will be no dirt left to be hauled away. The latter item of hauling, especially in larger cities, has become quite an expensive item because of the long hauls to dumps. The machine will not tamp around or beneath the pipe, but if hand tamping is done to within about 6 in. of the top of the pipe, the machine can readily be used.

Transportation.

Service Carts.—In Philadelphia, there are two types of ser-

Fig. 20.

vice carts, large and small, but as the large type is used exclusively by the main gangs, it will not be described. Of course, the idea is to get a good substantial cart that will be able to withstand a great amount of hard usage, and, at the same time, be as light in weight as possible in order that the men can easily move it from job to job. The small cart now being used is shown in Fig. 20. The box is 5 ft. 6 in. long, 1 ft. 10 in. wide and 1 ft. deep, and the box for the storage of oil is 2 ft. x 1 ft. 3 in. x 1 ft. 3 in. The main supporting beams are 3 in. x 2 in. and the axles are 1½ in. square steel. The wheels are 4 ft. in diameter. This cart weighs 650 lbs. empty and

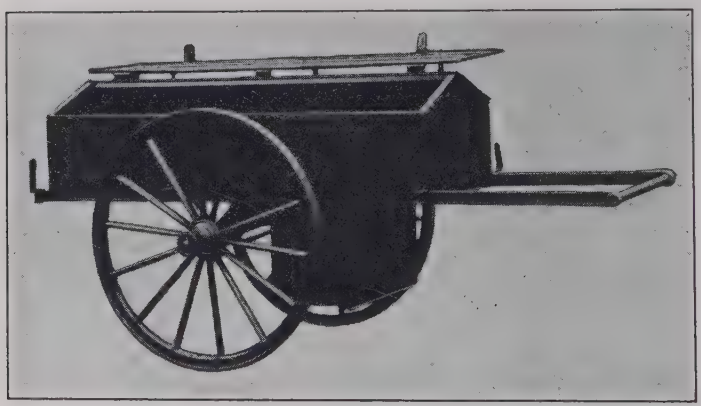


Fig. 21.—Steel cart weighing 425 pounds.

1,300 lbs. loaded. At the present time, we are working on plans with the idea of trying to make something that will be much lighter in weight and still be durable; Fig. 21 gives one of our experiments, a steel barrow weighing 425 lbs.

Main and Service Delivery Wagon.—Fig. 22 shows the design of wagon used in some sections of Philadelphia for the delivery of material. There are other sections of the town where motor vehicles are used. This wagon is known as a panel side wagon, 8 ft. 6 in. long, 4 ft. 6 in. high and 3 ft. 10 in. wide. The wheels are 2 in. wide, 50 in. high (back wheel)

Fig. 22.—Main and service wagon, drip wagon and cart.

and 36 in. high (front wheel) with axles 1¾ in. The weight of wagon is 1,705 lbs. with a capacity of 2,000 lbs.

Push Cart.—The push cart, Fig. 22, is a very handy article to have around any shop, and is used often for the delivery of service material when the location is near the shop. The body is 4 ft. long, 1 ft. 3 in. deep at the front and 12 in. deep at the back, and 21 in. wide. The wheels are 34 in. in diameter with 1¼ in. square iron axles.

Drip Wagon.—Fig. 22 gives a good idea of the general design of a 300 gal. drip wagon. In service work, a drip wagon is used very seldom, its chief function being to pump main drips.

Leak Wagon.—The leak wagon is of the same design as the main and service delivery wagon with the exception of having the front and rear enclosed with galvanized iron screening to prevent the theft of tools. The wagon is equipped with the following tools and material. It can be seen from the equipment that this wagon is ready to care for leaks on services or mains:

6 asphalt cutters
1 asphyxiation kit
1 axe
1 box key
1 box torch
2 brick hammers
3 buckets
1 bell rammer
4 bursting wedges
1 box shovel
3 3-in. x 12-in. x 12-in. blocks
3 1-in. x 12-in. x 12-in. blocks
3 caulking hammers
4 cold chisels
6 cape chisels
2 No. 2 cutters
1 No. 1 cutter
1 cross cut saw
10 qts. cement
1 gal. coal oil
1 drip key
drills—¾ in. to 2 in.
2 dog chisels
6 diamond points
1 drip pump
2 dope brushes
1 dope can
4 frost wedges
6 flags
1 file
guides and dies—¾ in. to 2 in.
4 pair gum boots
gum plugs—¾ in. to 2 in.
4 3-in. gum bags
4 4-in. gum bags
4 6-in. gum bags
4 8-in. gum bags
1 pair gum gloves
10 handles
4 12-lb. hammers

2 8-lb hammers
2 hand tongs
1 hand torch
2 handle diamond points
1 hand saw
1 hatchet
1 2-ft. level
1 gal. lard oil
6 lamps
2 tapping machine compts.
1 manhole hook
1 manhole bar
1 manhole hook with ring
1 orifice box
4 oil skin suits
2 orifices
6 picks
1 pair pliers
1 pipe vise on wagon
6 ¾-in. plugs
6 1-in. plugs
6 1¼-in. plugs
6 1½-in. plugs
4 2-in. plugs
1 respirator
1 ratchet stock
1 6-ft. rule
2 ropes—1¼ in. to 20 ft. long
10 qts. red clay
4 search bars
4 stone bars
2 ⅜-in. steel rods
6 shovels
3 ⅜-in. smelling rods
1 stop key
25-ft. service wire
2 sleeve wrenches
2 6-in. stoppers
2 8-in. stoppers
1 squirt can
1 screw driver
1 set caulking irons
8 lb. soap
4 tunnel bars
2 trowels
1 tape line
2 tie chains
2 test brushes
5 yds. tallow cloth
1 valve key
1 6-in. water gauge
2 18-in. wrenches
2 14-in. wrenches
1 10-in. wrench
I 18-in. wall chisel
1 24-in. wall bar
4 ¾-in. wooden plugs
4 1-in. wooden plugs
2 2-in. wooden plugs
2 3-in. wooden plugs
2 4-in. wooden plugs
2 6-in. wooden plugs
6 1½-in. x 4 in. x 6-in. wedges
2 3-in. x 5 in. 12-in. wedges
2 yarning irons

In a section or locality where a leak wagon would be in constant use, there is no doubt that a motor vehicle fitted with the same tools and material would be a big saving.

Motorcycle.—The service foreman and service inspector use motorcycles and, in this way, save a great amount of time, as we figure that a man on a motorcycle replaces two men on bicycles. The average total cost per day owned for motorcycles in Philadelphia, for 1913, was 33 cents or 59 cents total

cost per day in service. In figuring this average, 10 hours per day was the basis.

Bicycle.—The bicycle, Fig. 20 used by the cart foreman is one that is manufactured by The United Gas Improvement Company in Philadelphia, and is used on all kinds of work. We have had wonderful success with these machines, both as to life and to low cost of maintenance. Below are several items that may be of interest:

Weight of wheel—38 lbs.
Frame made of 1⅛ in. tubing—No 16 gauge.
Front fork consists of three-piece crown with sides of No. 16 gauge tubing.
Fauber standard hanger with ¼ in. chain.
New Departure hubs with heavy spokes and heavy wood rims.
Extra heavy handle bars.

Organization of Force.

One of the most important features in service work is the organization of the working force. A harmonious and mechanical combination must be established to get the greatest efficiency. In building up this force, two important features must be considered: First, the men must be capable of delivering to the public the standard of work and promptness set down by the company they represent; secondly, the work must be done at the minimum cost. Deep thought is required to properly adjust such an organization. The size is naturally governed by existing local conditions and the scale of operators. Under the following headings, I have endeavored to describe the organization that I believe would be the most efficient.

Small Towns.

In a small town or suburb of a large city, the work is mostly confined to the laying of new services, the natural supposition being that a progressive community is featured by the erection of new dwellings and business houses. The work being light,

both main and service work would be supervised by one man, the general street foreman, who is directly responsible to the superintendent. In this discussion, I will, however, refer to him as the service foreman. The service foreman's duties in the above case are of such variance as to comprise much detail. He would preinspect service locations, route work and direct movements of service gangs, order out material and check it on the job, inspect completed work, audit work cards, orders and reports of the gang foreman. He would also act as timekeeper and, in general, do any clerical work necessary to clearly define the progress and movements of the department.

The majority of new work would be widely scattered as most new buildings would comprise either single or double dwellings with the exception of a few large operations, that is, blocks of houses built in rows that are generally erected on the outskirts of a town.

The maintenance of old services (repairs, renewals and stop box work) would not involve a great amount of work and, in proportion, would be no comparison to new work.

In connection to laying services to blocks of houses, the service foreman does not have to give as much attention to the gang foreman as he ordinarily would on scattered work, renewals and repairs, as the gang foreman becomes so familiar with handling the few obstacles arising on this work, he is competent to handle them himself.

The personnel of a service gang for scattered work would be comprised of a gang foreman, one driller, or handy man and two laborers. The gang on operation work would increase the number of laborers to possibly six men, the exact number of laborers, however, being based on the number of services to be laid, their average length and location of service cart. An important phase is to locate the cart properly to give the gang foreman an unobstructed view of all his men. The foreman devotes much of his time at the cart, cutting and threading pipe. The more services laid without the moving of the cart,

the larger number of laborers the foreman and driller can keep employed.

On scattered work, the duties of the gang foreman and driller are of a more laborious nature as they must use pick and shovel to aid their two laborers in excavating and refilling the trench.

The service gang foreman should be a man of good intelligence, having a thorough knowledge of service work and a good understanding of main work. He must be progressive and have executive ability. Generally this man is a product of both main and service departments, although a driller or handy man with proper qualifications is sometimes selected.

Large Cities.

Owing to the large area of ground to be covered in a large city, it is generally advisable to divide into districts, each district or section embracing about the same amount of territory. This does not necessarily mean that each district will have the same number of consumers, as it is needless to say that the district or districts covering the congested portion of the city will have the largest number of consumers. Consequently, I have made two divisions under the headings "Large" and "Small" Districts or, in other words, congested and outlying districts.

Large Districts.—Service work in the congested or business portion of a large city differs decidedly from conditions previously described. The work principally involves the renewal, enlargement and maintenance of existing services which, in the majority of cases, means interference with foreign structures. It is generally of such an extensive nature that it demands the attention of one man at the head of the service department, namely the service foreman. He must consult with representatives of other companies having structures in the ground, and with architects and builders to determine service locations and data of probable consumption to enable him to decide on the size of service to be installed. He will, in general, govern the movements of his gang foreman through an inspector, dis-

patch work and audit completed work cards. As a rule, the service foreman will not be able to oversee much of the actual work, but must depend on his inspector for this part of his work. An inspector takes care of from 4 to 6 gangs; he must be a practical man of good intelligence, having a thorough knowledge of main and service work. In selecting such a man, personality and executive ability must also be considered. A man who has won the respect of his associates and through perseverance, has shown his superior knowledge of the work and natural ability as a leader, is the man wanted as an inspector. His duties will be to determine or approve the locations of services in ordinary cases, the nature of material needed and the desired time of delivering material. He acts as timekeeper for his men, inspects completed work, assists gang foremen in making up work cards and reports, and acts as an intermediary between the service foreman and gang foremen. The inspector is of especial value for pre-inspection work, which will be discussed later on in the paper.

Service work in congested districts is usually slow and difficult from the presence of numerous underground structures. The dense street traffic is prohibitive of an extensive amount of ditch opening at any one time, and renders advisable the filling up of all openings at night. All these conditions are contrary to the economical use of a large service gang. The personnel of such a service gang would be a gang foreman, one skilled laborer or handy man and two ordinary laborers. The foreman would do the tapping, cutting and threading. It might be well to state that if the gang foreman was equipped with a bicycle, he could, at times, handle small jobs nearby, embraced under the heading of stop box work, either going himself or sending the handy man.

Small District.—Service conditions in the small district or the growing fringe of a large city are comparative with conditions under the heading of "Small Towns." While its service work is on a much larger scale, it is, in general, the same simple operation over and over again, but does not involve the

complications attending service laying in the congested portions of a large district. The bulk of the work consists of operation services (as before stated, services are laid in batches of 50 or more to blocks of houses in course of erection), but on a much larger scale than that of a small town.

A prevalent condition in the small district is that of isolated residential sections, that is, villages, possibly 1 to 3 miles from the main settlement. The most economical means of handling this condition is to have a service cart fully equipped, located permanently in each of these isolated sections, a card record being kept by the service foreman as to the location of carts. This system, by actual experience, reduces the number of gangs by, at least, one. It does away with long pulls that not only take from 1 to 2 hours en route, but tires men to such an extent as to render them 50 per cent. below their normal efficiency; and it is cheaper than moving the cart behind a delivery wagon.

Taking for granted, that there is not sufficient work in each isolated district to warrant the permanent location of a gang there, it is clear that it is easier on men and much cheaper to send them from the main settlement to the isolated section on trolley cars than to make a long pull with the cart. It might be of interest to state that the lamping of a cart when idle in these isolated sections is seldom required, as vacant lots are nearly always available for storage. Experience also shows small loss of tools by stealth, or disfiguring of cart; the friendly attitude and respect of the community, through good service and fair treatment, protect your interests.

The personnel of a service gang for a small district is similar to that of a small town. The service foreman and inspector's duties will be similar to duties requisite to a large district.

Shop Organization for Delivery and Collection of Material.

A most important feature in connection with service work is the material with which the work is done. It is therefore imperative to keep an ample stock of the various articles used

daily, and a constant reimbursement of stock to offset the output. In plain words, the shop store room should never be in the position that would render them unable to fill an order for the service department, calling for material in daily use. This means that a close surveillance must be kept over stock of this material and the shop "storekeeper" should appoint a responsible man, directly under his supervision and accountable to him, to fill orders, direct deliveries and collections and keep up the stock.

The next point to be considered is the delivery and collection of material, which should be done in a systematic manner; a good system would constitute two deliveries daily, one in the morning and one in the afternoon. This would necessitate the service foreman and inspectors depositing delivery and collection orders in the hands of the store room helper not later than 11.00 A. M. and 5.00 P. M., enabling him to fill orders, load wagons and direct route before departure of teams, the time set for departure of teams being 7.30 A. M. and 12.30 P. M. It is highly important that this routine is carried out, and it is up to the storekeeper to see that the teams are absolutely away on time. Any holding up of teams on account of laxity on the part of the service foreman or inspectors should be reported to the superintendent, by the storekeeper, that the fault may be immediately corrected.

Punctual receipt of orders in the store room also enables provision for extra teams on "heavy" work days, and also conditions encountered with bad weather.

Orders for material out of the ordinary, such as large wrought iron pipe and fittings, cast iron specials and large tools should be handed to the storekeeper as far ahead of time set for installation as possible, to enable him to procure them before the date desired. The service foreman and inspectors should take every means possible, both verbally and in writing, to make clear their needs of the store room. If the orders are written distinctly as to nature of material, kind of tools, classification of work that material or tools are to be used for,

and address, the store room can make their deliveries and collections creditably.

Installation.

Preliminary Work.

Preinspection of Work.—Preinspection is probably more necessary in service work than in any other department of the business. Much time and money is thus saved, and it cannot be too highly recommended.

The first preinspection of a service job will be, as I have stated under the heading "Design of Service System," to supply the builder with sleeves made of stove piping to be placed in the foundation walls. Occasional visits should be made during the course of foundation laying, first, for the purpose of seeing that the sleeves are placed at the proper depths, and, secondly, to make arrangements as to the time for installing services. Careful planning is necessary with the builder and sub-contractors to insure the proper time set for service work in order that there may be no building material in the way. Many times it is necessary to plan the work several weeks in advance, due to the large number of building operations. It is easily seen that several visits by the service inspector or service foreman, to a job, will be necessary before the cart foreman is ordered to pull his cart to the location to start work. At the time of these visits, the size of the service is determined and the material ordered out.

With large buildings, it is absolutely necessary that arrangements be made for a sleeve to be placed in the foundation wall, as, in most cases, the wall will be from 3 to 4 ft. in width. Besides being a very hard job to drill through, if sleeve is not placed, it is also very much against the rulings of most builders to have the wall tampered with after being built. The great value of the sleeve lies in the fact that many walls, especially on operation work, are of very inferior construction rendering any openings difficult to make without affecting their stability. When sleeves have not been placed in the

walls for the entrance of services, and there is reason to believe that the walls are then in bad condition, or will become so when broken into during service work, the foreman should make a careful note of the conditions and have photographs taken. These precautions will minimize any actual damage and prevent claims for conditions existing previous to service work. Under any bad conditions, no work should be done without securing a release from the owner.

In case of services to new isolated houses, building material is less apt to be in the way, and for these services the proper data for laying is easily arrived at.

Service renewals, forming the larger part of the work in congested districts, involves preinspection mainly for size and location, as the time for the work is almost always the earliest date possible. However, when the work requires the discontinuance of the gas supply, the exact time becomes of great importance. This is especially true in buildings where many industrial appliances are used. Under all conditions, it is well that the person for whom the service is to be run or renewed knows when the work is to be begun and what paving will be removed. Often, a little hitch of this kind will compel the cart foreman to stop the work at a location simply through the consumer not knowing the details of the case.

Order for Work.—In order to avoid confusion with wrong address, location, etc., it is always advisable to assign no work whatever to a service gang without a written order. This order can very conveniently be made in the shape of a card measuring 3 in. x 5 in. On this card will be the house number, with the size and location of the main from which the service is to be run. This card will be described later under the heading of "Recording." It eventually becomes the record for the work done.

If often happens that a service gang foreman will be an exceptionally good man, but is unable to do clerical work. In this case, the service inspector or service foreman, as the case may be, should make out the cards.

Delivery of Material.—On large operation work, where a large amount of material is required, it is delivered directly to the site. By this I mean that material, such as pipe and stop boxes, is sent from the main store room and not from the district shop where a limited amount is kept. This saves district handling and much time and expense. Fittings and stop cocks are generally delivered to the gang from the district shop the morning the job is started. This material, being more valuable and easily stolen, is taken care of by the gang foreman.

Material for isolated jobs, as a rule, is delivered the day before the work is started, and, if possible, is left in the cellar of the house for which the work is to be done. It often happens that there is an objection raised on the part of the consumer to putting the pipe in the cellar, but it rarely happens that a place cannot be found for the fittings and stop cock. When the objection is raised as to the storage of pipe over night, it is either left in an adjoining cellar or in the street, close to the curb.

In this phase of the work, the service foreman or inspector has a wonderful opportunity to exercise his good judgment as to deliveries, for in some instances, especially in cases of dense traffic, the material cannot be delivered before the gang's arrival, and it is necessary, if no time is to be lost, to have the delivery wagon on the job just about the right time.

Preparing for Trench.—The location of the service having been decided upon in accordance with the principles laid down in the "Design of Service System," the trench is worked out by the gang foreman. Should there be any deviation from the ruling as to location, the service foreman or inspector will mark the desired location on the wall, besides telling the gang foreman of the circumstances. The width of the trench varies from 16 to 18 in. The length of the opening at the main would be 4 or 5 ft., according as one or two services were being run in the same trench. The width of this main opening would,

of course, vary as to the size of the main, but it should be made as small as possible to save paving.

Removing Paving.—Removing paving over the main for service connection is practically the same as for main work, so I will not touch upon this subject with the exception of mentioning that care should be taken in cutting asphalt that the flying chips do not cause trouble, either to pedestrians or windows. Asphalt screens may be used, or closing the shutters of houses close by, may answer. In this work, the small amount of asphalt cutting hardly warrants the use of the screen. It is very simple to have the men stop cutting when pedestrians pass by.

Roadway paving material should be piled inside or outside the curb, as local conditions might indicate, while the footway material should go to the curb or against the house. The general aim should be to remove it from the line of traffic.

Where sod is encountered, it should be cut and removed with care and so piled that it may be replaced in its original position. Canvas covers should be provided to protect the lawn from the excavated material. The above precautions, combined with good tamping and sod ramming, will result in the slightest possible harm to the lawn.

Trenching Precautions.

Earth Excavation.—The same precautions, for the protection of the public, of the workmen and of the trench should be taken for service work as when laying mains. The excavation details are also similar for the two classes of work. In the absence of rock, service trenching involves no more difficult problems for the cart foreman than the obtaining of the greatest amount of work from each individual digger. The best methods of securing good results in the digging line is to have the cart foreman set the pace. There are cart foremen who object to this, but a man who is really interested in his work and knows by getting his costs low, he will receive increases in pay, generally forgets his pride and works with the one end in view—that of doing the work at the minimum

cost. It is always good practice to leave the paving at the gutter intact to prevent any water entering the trench and possibly running into the cellar. The place to start is over the main so that the tapping can be done and the fittings screwed in while the rest of the excavation is proceeding. The house wall is another point at which it is well to start early in the digging. When an opening has been made at the right depth, then the trench can be bottomed in a straight line between this hole and the top of the main. If the soil is good, care in the bottoming of the trench is worth while, for then the service can rest directly on the earth with practically no blocking. It also removes any fear of settlement with possible trapping or leaking fittings, due to the strain. The proper depth for services has already been spoken of in discussing the "Design of Service System." The minimum grade should be 1 in. in 12 ft. The ordinary grade will be 3 or 4 times as great.

Rock Excavation.—It rarely occurs that blasting is necessary in service work. Where it is known that rock is to be encountered, especially on operation work, it is well to wait until the plumber has completed his work and use his trench, as explained under "Design of Service System." I have shown some tools in Fig. 7 that are used in removing rock should a small amount of it be found in the trench.

Tunnelling.—There are times in service work when tunnelling is preferable to open excavation, both from the standpoint of economy and paving preservation. There appears to be a growing tendency to prohibit tunnelling in general, but in service work, the distance is generally very short and the refilling can be, with good supervision, sufficiently well done to prevent subsequent settlement of the concrete base. If the soil should be ashes or other bad fill, tunnelling is not advisable, first, because the soil will be hard to tamp back, and, secondly, because an open trench is necessary to surround the pipe with the good earth required for its long life.

Drilling or Driving.—In some cases of service renewals, drilling or driving is advisable, generally to avoid disturbing

some cement footway that the property owner is proud of or is dubious of the company's success in color matching the broken blocks with the remaining paving. There are no difficulties when the new service takes the location of the old one, but this condition happens very seldom. The old service is usually too shallow at the house and the new one must start at a lower level and then most of the cement footways are underlaid with ashes to the service depth, so that a driven service will be surrounded by ashes, while with an open trench this could be avoided.

Driving is accomplished by fitting the end of a piece of pipe with a driving point, K, Fig. 7, and then forcing the pipe outward from the cellar by blows from a heavy sledge or a wooden block held against the pipe. When the point has appeared in the trench outside the curb, pipe and all are withdrawn into the cellar and the service pipe shoved through the hole thus left. In ashes or other loose soil, the opening is not apt to remain and this may force the using of the pipe behind the point as the service pipe, assuming that it has not been hurt in the driving process. Of course, the pipe does not always drive in the direction intended, and the operation must be repeated until the desired location is obtained. Even if the point appears where expected outside the curb, it does not necessarily follow there will not be a trap in the pipe as driven. The existence of this trap can, of course, be told by pouring a measured amount of water into the pipe and noting any lack in the issuing quantity.

Drilling is a variety of driving when a drill is used, and the pipe is revolved as it advances. It is used mostly in clayey soils.

Laying.

General.—When both service and main work are on a small scale, any services from a main extension will usually be laid as part of the main job. This will save a second opening over the main, enable the tap holes to be made before the main is gassed, make the supervision of all work easier for the one

foreman, and, in general, keep the small force of street men employed to better advantage than if the work was done at separate times. On a large scale of operations, there are so many cases of new and renewed services from existing main, that service gangs as distinct from main gangs are required, and this calls for a separate service organization. Having such an organization, it will be generally found most advantageous to lay all services from main extensions after the main work has been completed, and to limit the joint operations of main and service gangs to cases of main renewals, when the old main must be put out of use as the new main is laid.

On occasions, usually in the late fall, there may be one or more locations where cement footways must be laid to avoid cold weather, before it is possible to run the main. If no service gangs are available, wooden ducts should be furnished the builder and properly located for future use. The use of these ducts is more or less objectionable because of the probability of their not being in exactly the right position and the impossibility of filling the space between pipe and ducts, thus increasing the chance of corrosion and also of a street leak entering the house. Therefore, it is advisable to make an extra effort and lay the service from the house to the street for future connection to the main by means of a long screw. Here it might be stated that unions with washer joints should never be used for underground work.

Pipe Cutting.—As a general rule, for sizes 2 in. and smaller, all pipe cutting should be done on the job, by use of stock and die, with pipe held fast in the vice attached to the service cart. Power cutting to measurement, at the district shop, is profitable for the larger sizes, and also for all sizes where, because of a constant distance of main from curb, and standard stop cock location, the length from main to stop cock will be the same for each of 40 or 50 houses in a block. Another advantage of this cutting at the shop is that it enables the utilization of accumulations of short pieces of pipe, two of which are combined to form one stop length. In the absence of short

lengths brought to the shop from many jobs, cutting of stop lengths there would be a disadvantage if it meant bringing to the shop and, therefore, rehandling pipe that otherwise could be taken from the central coating shed direct to the job.

The preinspection of large services for the purpose of taking measurements so that pipe may be cut in the shop, is affected by the existence of obstructions. Usually, unless before the trench is opened, it is known how the pipe should be cut, cutting at the trench side, by a hand power machine, is preferable to taking the measurements after excavation is complete, and sending back to the shop for the cut material. The general characteristics of the tools used for this work have been discussed in the part devoted to "Equipment."

Connecting to Main.—It was stated before that the first opening should be made over the main. This is because service laying begins at the main and the work there requires the greatest amount of time. The first operation is tapping the main. The size of opening is determined by the size of service and also, on small mains, by the main size. Below is the Philadelphia schedule:

SCHEDULE OF SERVICE CONNECTIONS

Size of services	Size of main: 30-in. hole. Inches	20-in. hole. Inches	16-in. hole. Inches	12 in. hole. Inches	8-in. hole. Inches	6-in. hole. Inches	4-in. hole. Inches	3-in. hole. Inches	2 in. hole. Inches
1	1	1	1	1	1	1	1	¾	1½ S.S.
1¼	1¼	1¼	1¼	1¼	1¼	1¼	1	¾	1½ S.S.
1½	1½	1½	1½	1½	1½	1½	2 S.S.	1½ S.S.	1½ S.S.
2	2	2	2	2	2	1½	2 S.S.	1½ S.S.	1½ S.S.
2½	2½	2½	2½	2½	2	3 S.S.	2 S.S.	4 x 4 T	—
3	3	3	3	2½	3 S.S.	3 S.S.	4 x 4 T	4 x 4 T	—

4-in. and larger given in schedule under heading of "material."
1½-in. S.S. equals Split Sleeve Tapped with 1½-in. hole.

Adherence to this schedule will tend to prevent mains breaking by reason of weakness at the service top. Such breaks are not surprising when cases are known of 2 in. holes tapped in 3 in. mains. Were mains of this size not being abandoned rapidly, any service connection to them without the use of

sleeve or tee might be considered unwise. The only reason above for using split sleeves tapped for a different size than the service being laid, is to decrease the variety required for stock. Figs. 23 and 24. The use of the 4 in. x 4 in. tee for 2½ in. and 3 in. services on 3 in. mains results from not buy-

Fig. 23.—Method of connecting service to a small main.

ing any 3 in. tees. If any were on hand, recovered from old mains, they would be used. The reduction of the tap hole diameter below that of the service, is simply taking advantage of the fact that the smaller opening, because of the short length, will deliver gas to the full capacity of the longer pipe.

As a further insurance against weakening the main, there should be, at least, 9 in. between each tap hole, Fig. 25.

The method of inserting branches and split sleeves can be found in Mr. Walton Forstall's paper on "The Installation of Cast Iron Mains." A general description of the tapping

Fig. 24.—Same as Fig. 23 with the exception that the sleeve is turned on side to either get greater cover or to pass an obstruction.

machine, Fig. 8, has been given under "Equipment." Detailed instructions for operating the machine are furnished by the makers. Ordinarily its use involves an excavation to the bottom of, and all around, the main. On mains 20 in. and

larger, this entails considerable, and often particularly difficult work which may be avoided by the use of the device shown in D, Fig. 8, as after excavating to the center of the main, the hook may be forced around under it.

Fig. 25.—Two services in one ditch.

The normal location of the tap hole is on top of the main, as shown in Fig. 25. However, any location within 90 deg either way from this point is acceptable if needed to afford sufficient service depth, avoid obstructions or prevent a service drip. Fig. 26 shows a connection on the side.

The hole, being tapped, is ready for the insertion of the first fitting. This is the street tee, Fig. 26. When the hole is tapped in the side of the main, the outlet of the tee should be to your right as you face the main. This will cause any bearing down strain on the service to tighten the tee, and thus

Fig. 26.—Service connection with hole tapped in side of main.

prevent the elbow from getting below the tee and forming a trap. When the hole is smaller than the service, the reduction is made in the tee, thus entailing a minimum amount of restriction. For instance, with a 1¼ in. service from a 3 in. main, the street tee would be ¾ in. × 1¼ in. × 1¼ in. The great

advantage of the tee over an ell for this first fitting is the ability to stop the gas flow during service laying by the insertion of the rubber plug, Fig. 27. This is placed in the tee before it is screwed in the main, and effectively protects the workman from any gas. Another advantage of the tee, but

Fig. 27.—Four services in one ditch, showing the method of inserting rubber plug in head of service tee, stopping the flow of gas.

one seldom needed, is the possibility of access to the service interior without cutting.

The second fitting is a street ell, Fig. 26. The combination of the two fittings secures a swing joint at the main, thus

allowing the easy adjustment of the service pipe to any grade, without bringing strain on pipe or main, and ensuring that any future strains on the pipe will reach the main, if at all, in greatly diminished extent. The only valid objection to the substitution of this connection for the straight pipe in the side of the main, or the single ell connection, viz., the increased chance of naphthalene or frost stoppage at the additional turns, disappeared with the modern practice of laying larger services and of overcoming the naphthalene troubles.

Both of these fittings should be of galvanized malleable iron. The galvanizing not only adds to the length of life, but also fills up sand holes, thus decreasing the chance of service leaks. Also, the fittings, as well as any service cock, should be provided with recessed shoulders long enough to completely cover any male threads joining with them and not engaging with the female threads back of the shoulders. In this way, these threads may be thoroughly protected from corrosion.

Pipe Laying.—Before laying any pipe, it should be looked through to detect any internal blister or other obstruction, and any necessary cleaning effected by rodding or jarring. It should also be examined for any defective weld, though all coated pipe has been previously so examined prior to coating. The threads on coated pipe are often clogged by coating or dirt, and should be cleaned by running a die or fitting over them. The factory coupling should be backed off, reversed and then screwed tight.

Both street tee and ell being in approximately the right position, the first length of pipe is screwed into the ell. In making this, as all other joints, some jointing material is used. There are many varieties of these to suit all tastes. Possibly white lead and red lead are the favorites. Philadelphia, for some years, has been using cement and linseed oil. This has the merits of original cheapness and small waste because of non-hardening tendency. Whatever "dope" is used should be applied to male threads only and evenly spread.

After laying the stop length, in the case of a main on the

near side of the street, or a full length and cut piece when the main is across the way, we are ready for the installation of the stop cock, if any. Stop cock design has already been covered, and we are interested here only in the placing of the type selected. Before any stop cock is screwed on a service, the cart foreman should see that the plug turns with just the right amount of effort. If it screws too tight or too loose, it is generally wise to send it back to the shop for adjustment. The disadvantage of making these adjustments on the street is that there will be as many standards as there are cart foremen.

In screwing up the cock, the wrench should grip the end engaging the pipe. This avoids the strain that would come upon the barrel if the wrench were placed on the other end.

The house end of the service should project between 2 and 3 in. beyond the inside of the cellar wall. If after the completion of the service, no meter is to be set, the house end is capped and the stop cock left shut. At the time of meter set, a tee is screwed on the service end. Thus, by removing a plug, there is always an opening in the head of the service and of its full diameter, available for wiring or any other method of removing obstruction.

It is supposed that the service has been laid in a straight line at right angles to the curb. Occasionally, the line is oblique, and more rarely, being perpendicular, offsets may be required in either horizontal or vertical plane; 45 deg. ells should be preferred for offset work, the requirement for which in a vertical plane, is usually due to the location of houses on ground well above the street level.

Very rarely indeed when obstructions interfere with a straight line in the vertical plane, and a service drip is inadvisable, a double line of pipe, Fig. 1, may be laid around the obstruction, the lower leg draining away the condensation, and the upper leg conveying the gas.

Conduits containing cables carrying high tension current should be given as wide a berth as possible, and when forced

to cross under or over them, the pipe should be carefully blocked to prevent future contact and possible burn-out.

Blocking.—To prevent joint strains and trapped pipe, the service should be properly supported. The best support is that furnished by undisturbed earth. Where this is not available, blocking of standard size is advocated, in place of the practice of using any handy brickbat or rock. The natural blocking places are at the main, the stop cock and under each joint. The pipe should be supported by trench bottom or blocking, at least, every 6 ft.

Testing.—The service having been laid and supported, is ready for testing. This is done under gas pressure with soap suds applied by a brush to all parts, joints, fittings and pipe surface. The very fact that leaks in new service work are so seldom found has a tendency to make this test a very perfunctory one. So the service foreman should be on his guard in this connection and severely reprimand any workman covering over a leak that should have been caught by the test. When services are laid in advance of main work, it is safe, with good workmen, to omit any test. At the time the connection to the main is made, an examination by smell should be made at all stop cocks and house ends.

Placing Stop Box.—The stop box has been previously described. In placing it over the stop cock, the flange bottom should rest firmly on earth, blocking or bricks, at a height allowing 2 in. clearance of box over pipe. The barrel of the box should be carefully cemented over the stop cock, and earth tamped firmly around to hold it in this position. The top extension piece should be adjusted to the probable height of the footway paving.

Pipe Protection.—The application of a preservative coating on the pipe has already been described. Because of the handling experienced from the coating shed to the trench bottom, the coating is never entirely intact on any completed service. Also, the fittings have never been coated, though if they are galvanized, coating is hardly necessary. However,

the application by brush of a second coat to the entire service as it lies in the trench is well worth while. As an additional precaution, muslin has been wrapped upon this second coat, and a third coat then applied. No reliable data exists as to

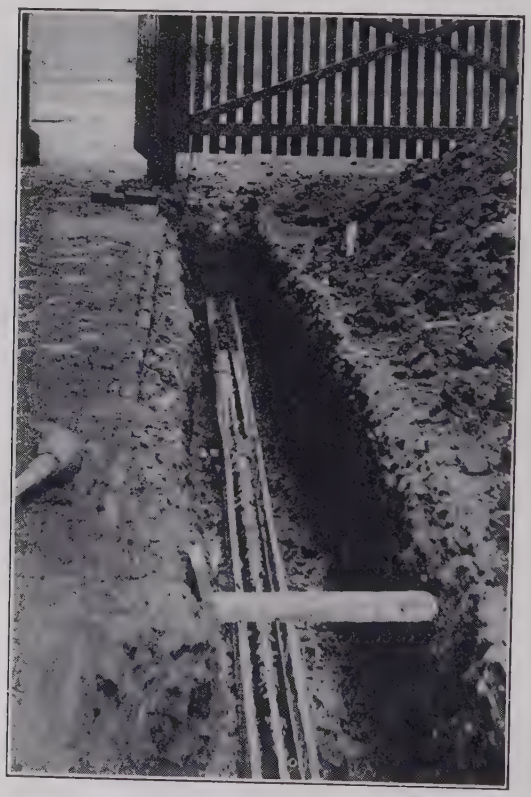


Fig. 28.—Rectangular box method of protecting service in bad soil by surrounding with pitch.

whether the muslin protection is warranted. Probably in bad soils it would be of little avail, and in good soils, it is not required.

In very bad fill, pitch protection or galvanized pipe, is recommended. For 1¼ in. services, wooden forms are placed

around the pipe and pitch poured in. This leaves the service enclosed in a tube of pitch about 1 in. thick. Figs. 28 and 29.

Cement has been used in place of pitch, but there is great difficulty of obtaining proper adhesion to the pipe, and without

Fig. 29.—Triangular box method of protecting service in bad soil by surrounding with pitch.

this, moisture gets access to the pipe, and being held there by the cement, the pipe corrodes faster than without the cement covering.

Refilling and Repaving.

Refilling.—Refilling plays a very imporant part in service work and must not be slighted in any way. There is always a great opportunity to skimp this portion of the work as loose filling or puddling is so much cheaper than ramming. No matter what the condition may be, the public in general is always disgruntled when there is an excavation made in front of their home and especially more so when it takes in their sidewalk and sometimes a lawn if they happen to have one. Service work involves the footway as well as the roadway, consequently, the muss is more under the consumers' feet than is true of main work, therefore, the policy should be to clean up thoroughly and promptly, leaving conditions as near normal as possible. Any material that cannot be taken away by the service gang, should be piled in the least objectionable place, pending its final removal.

Unless the expense is prohibitory, good soil should be placed next to the pipe in a layer, at least, 6 in. thick.

The majority of service trenches for new houses will be loosely refilled as sufficient time usually elapses before paving or sodding to admit of proper settlement. This is practically the only condition that will arise in service work where puddling can be done, and then it would be resorted to only with the idea of getting all the soil back into the trench. For services to occupied houses, usually renewal work, tamping is generally required for paving or sod must be immediately replaced. Puddling in this case is not desirable on account of the danger of water getting into the house and also of making a trench too soft for immediate topping with paving or grass.

The hole through which the service enters the foundation wall should be carefully closed in, and the wall on both inside and outside face thoroughly cemented around the opening. A water leak through a service opening annoys the consumer and reflects on the company.

Ramming.—In service work, good ramming is very essential. The footway ditch, especially, is repaved as soon as pos-

sible and in order that there be no settlement after paving, the soil must be put back in suitable condition to hold up the paving. Again, it would be very expensive if it was necessary to haul dirt away from service jobs, consequently, all the soil must go back into the trench and, in many cases, this cannot be done if good ramming is not adhered to.

The power tamping machine has been developed to such an extent that it now is beyond the experimental stage, and on any work where a large amount of ramming is needed, it not only proves cheaper, but does the work better.

Repaving.—As most companies find it advisable to contract their paving, I will not enter into the details of same, simply making mention of features that are necessary to insure good and lasting repaving.

Ordinarily the service gang will do no permanent repaving, either leaving the trench mounded over and guarded by danger signals, or flush with the neighboring surface, with or without temporary repaving. Belgian block or cobble lend themselves to temporary repaving with the consequent avoidance of lamping expense and street obstruction, pending permanent repaving. Of footway paving, no temporary restoration is usually made. The paving material, if footway, is ordinarily piled neatly close to the house and, if roadway, at the curb line or house line, as indicated by local conditions.

Recording.

Reasons for Records.—Generally speaking, service records are not as essential as main records, but they are, however, an important record and can, by intelligent use, be made a valuable adjunct to a distribution office.

Herein are enumerated some of the uses this record can be put to, and which constitute good reasons for its existence:

(1) When digging for a service for leak, or other reasons, and its location cannot be gotten on account of the house being closed and the stop box paved over or

sunk in a dirt plot (which is a common occurrence) the service record supplies the information.

(2) Assuming a condition of no main and service records, such as The United Gas Improvement Company encountered when it took over the Philadelphia Gas Works by lease in the year 1897, the service records kept by this company since that time have been practically the only source from which any information could be gotten, for some years, about the distribution mains laid prior to 1897, and even up to this date, 1914, they are still a prolific source of information regarding the location of what we term "Old City" mains, and also the condition of the services (modern or the reverse) along the lines of said mains.

(3) The age of a service can always be had by reference to the service record which is an important matter where a service has suffered premature decay, as immediate inquiry into the causes might disclose the necessity for taking precautions to protect other important structures in the vicinity.

(4) The service records are often called upon to decide that the company's work was not responsible for paving troubles complained of.

(5) When services are run or renewed from main to curb or curb to house only, the service record showing this and the reason thereof, is a source of valuable information, when the question of running or renewing the other half comes up.

(6) Containing as they do, the length and size of the service, they conveniently furnish material data for comparative cost and valuation purposes.

(7) In altering a building containing a service, the head of the service is often left imbedded and concealed in the foundation wall, and as the stop box is usually

covered over in these cases, the service record prevents a new and superfluous service from being run.

(8) On large services, controlled by valves instead of cocks, the record shows the number of turns required to open and close the valve, and also the direction of the turns.

(9) Its use, on "Locate Stop" orders, in giving the stop location is quite obvious, in cases where the stop has been paved over or sunk in a dirt plot, etc.

(10) The record is indispensable from an economic standpoint where new meter set orders are concerned. We may make a final fixture inspection and record the fact of "No service in" on it, but this information may or may not be obsolete, two or more days hence, and would be of no value upon the receipt of a meter set order at a subsequent date.

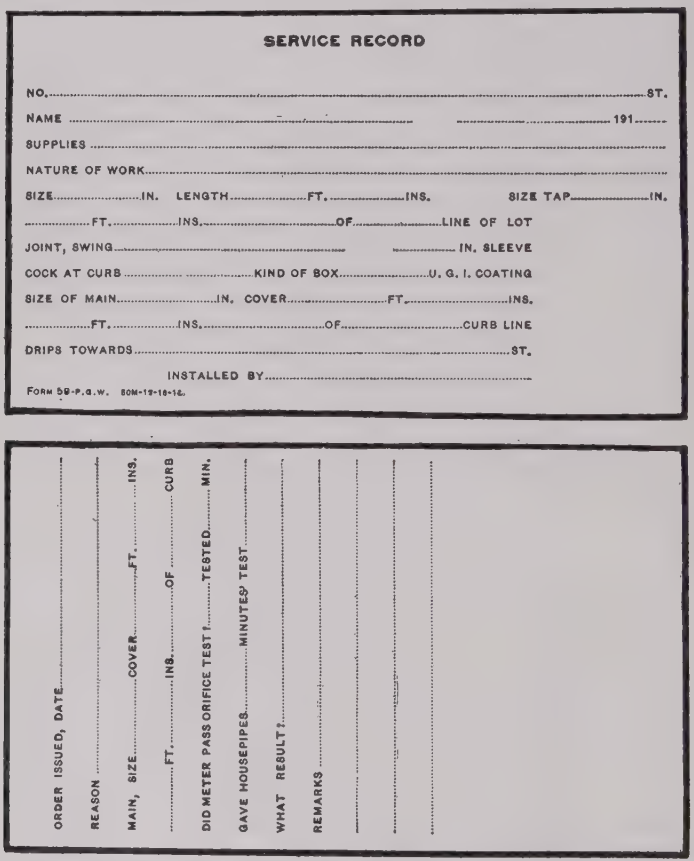
(11) It is a valuable asset from a Claim Department point of view in disposing of "Water in Cellar" complaints where the company is not at fault, and likewise in providing information to enable a quick remedy where the company is at fault.

(12) It also enables us to give a quick answer by telephone where contractors or other companies question whether a service is alive and active, obviating the necessity of a visit by us to get the information.

(13) In paving work, where resurfacing is going to be done, the service records containing the date of installations would be valuable in making a decision whether or not to renew the services and save paving cost for doing it in the near future.

System of Records.—Location: The service record used in Philadelphia is a card as shown in Fig. 30, and has proven to be quite a compact and economical location record. It is printed in duplicate, the two cards being fastened along the bottom edge, the back of the original being blank while that of the duplicate contains printed matter with blank spaces to

be filled in before the card is given to the service foreman, giving the date issued, the reason for issuing and the size, depth and location of the main. The receipt of the card by the service foreman is his authority for doing the work called for under "Nature of Work" and at the address on the order,


SERVICE RECORD

NO. ..... ST.

NAME ..... 191.....

SUPPLIES .....

NATURE OF WORK .....

SIZE ..... IN. LENGTH ..... FT. ..... INS. SIZE TAP ..... IN.

..... FT. ..... INS. ..... OF ..... LINE OF LOT

JOINT, SWING ..... IN. SLEEVE

COCK AT CURB ..... KIND OF BOX ..... U. G. I. COATING

SIZE OF MAIN ..... IN. COVER ..... FT. ..... INS.

..... FT. ..... INS. ..... OF ..... CURB LINE

DRIPS TOWARDS ..... ST.

INSTALLED BY .....

FORM 59-P.G.W. 50M-12-16-12.

ORDER ISSUED, DATE .....

REASON .....

MAIN, SIZE ..... COVER ..... FT. ..... INS.

..... FT. ..... INS. ..... OF ..... CURB

DID METER PASS ORIFICE TEST? ..... TESTED ..... MIN.

GAVE HOUSEPIPES ..... MINUTES' TEST .....

WHAT RESULT? .....

REMARKS .....

Fig. 30.—Service record card.

Fig. 30. All the other information called for on the face of the order is filled in by the service foreman (a carbon copy being made on the duplicate) when the work is finished, and is turned into the office that night. After a proper accounting

is made on the daily work reports, the original copy of the service record is sent to the records division and the duplicate remains in the district office, both being filed in geographical order. When a service is renewed or abandoned, the card for the original service is lifted from the active file, stamped "Renewed" or "Abandoned" as the case may be, and filed geographically in an inactive file; in the case of a "renewed" service, a new card is made out for the new service and filed in the active file.

Age: While the date of installation on the service card will always tell the age of that particular service, yet an age record is a very important one in cities, if the critical age of many services falls within the limits of several years, in which case there will be many service failures in the winters of the critical period, involving some more or less serious asphyxiations, and service repairs under *very* expensive conditions, and which can be obviated with a proper age record such as is used in Philadelphia, Fig. 31, and with which it would be a simple matter to investigate, each summer, a number of services of the critical age, and be guided by the conditions found, in determining upon necessary renewals. The record also furnishes, in convenient form, information for obtaining cost data, the illustration showing how, with a few entries, a record of the age, length and class of the service is completed, and it is quite obvious that the expense of keeping the record is slight compared with its value.

Cost: The record of material used for a service may be kept in a variety of ways. When there is a good reason for knowing the exact cost of each service, the back of the service card may be used for this purpose. In general, the obtainment of individual service costs is expensive and not warranted, as a unit cost per foot, of each class of service, suffices not only for estimate purposes, but also as an incentive to economical operation. Such unit cost is cheaply obtained by using as a divisor, the length totals of the age record book, and as a dividend the labor and material costs charged to the

SUMMARY OF SERVICES

District.

ADDRESS	Date Laid	Size	LENGTH NEW		LENGTH RENEWED		RENEWED U. G. I.		REMARKS
			Feet	Ins.	Feet	Ins.	Feet	Ins.	

Fig. 31.—Age record of services.

proper service account. The labor is reported on pay roll vouchers and the material on material sheets, one of which, for convenience, may include many services. As the proportion of large and small services laid by various districts or foremen is about the same, no sub-division of cost by size is required for incentive reasons. For estimate purposes, however, it is necessary to keep the cost of a few individual services of various sizes, in order to get a per foot cost for each size.

Maintenance.

Organization.

In service work, the organization for maintenance of services is practically the same as the regular force described under the chapter of "Organization of Force." With the ordinary winter conditions, the same force is well able to take care of all service leaks and repairs, the installation of new services being practically abandoned during cold weather when there is frost in the ground. It is always advisable to hold the regular summer force of men intact and not to attempt to force economy by too radical a lay-off. By keeping the old men, there is less liability of facing a serious leak situation with an insufficient force of trained men. The increased cost of the work done keeping these men busy will be more than offset by the saving in maintenance expense through using otherwise idle labor.

Linewalking.

The organization for a good linewalking system should consist of a force of men sufficiently large to cover the main and service system, regardless of weather conditions, at intervals frequent enough to render improbable any serious damage occurring to any main or service without the company's knowledge. There should be a chief linewalker, with as many additional linewalkers as the requirements, hereinafter mentioned, of the section or district demand. For linewalking purposes, the district or town should be divided into sections, and the

sections into routes, these routes being blue-printed and showing the streets to be patrolled, also the points at which the linewalker should sart and finish the route. The routes are covered in succession so that each section is sure to be patrolled in full before starting over again. In one district, in Philadelphia, for instance, one chief linewalker and four other men are able to cover 430 miles of mains and services in the district, about twice a week, on bicycles. (See Fig. 32.)

In severe cold weather, it is generally advisable to increase the force in order that the smaller mains may be patrolled oftener. In Philadelphia, during severe weather, it has been found necessary to have linewalkers patrolling at night, mainly in search of leaks. As a rule, these men do not cover the entire district, but are given sections in which it is known conditions are not of the best, due to foreign companies having done work in close proximity to our mains and services. These men receive special instructions and, as a rule, telephone to the office every 2 hours, giving the results of their work; at the same time, should the office have any special investigation to make in the immediate neighborhood, it is given to them. These men walk instead of riding bicycles.

Of course, the number of men to be engaged in night linewalking is determined tentatively. If the number of leaks does not warrant a large force at the beginning of cold weather, we gradually break in a number of men to work in relays, say, two men nightly, alternating weekly with two men working daily, and, in this way, they are well prepared to take care of any unusual conditions.

When a foreign company is doing extensive work, and our structures are constantly in danger, a special linewalker is stationed on the job, and in many cases a night linewalker has been needed as well. These men are instructed the same as the regular linewalkers, special attention being paid to the reports, being sure that they contain all data that might be of interest to the company.

In the following paragraphs will be found some of the

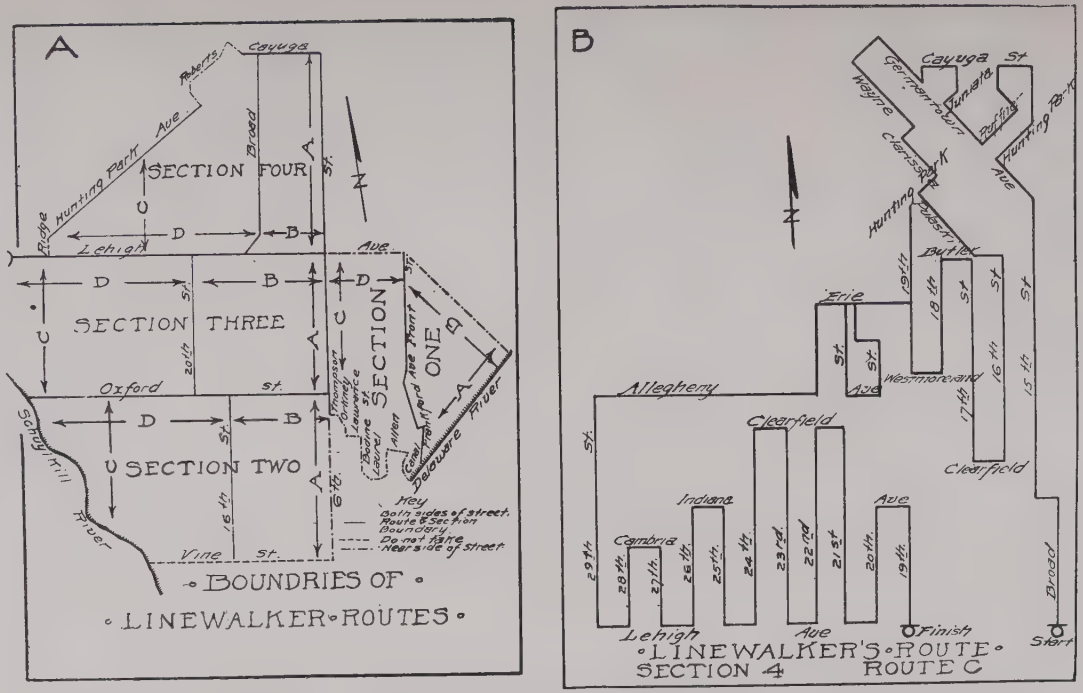


Fig. 32.—(A) A district divided into linewalkers' sections and routes. (B) One of the routes.

important duties that we compel the Philadelphia linewalkers to be familiar with and religiously live up to.

Linewalkers' Duties and Reports.—In general, the duty of a linewalker is to patrol the streets in which mains and services are laid, or new buildings are in course of erection, for the purpose of reporting any information that might be of value to the company; under this head would come work being done by any concern other than the company, such as building operations, work requiring openings in roadway or footway, etc.

For the purpose of having a complete record of just when a certain street or section was covered by a linewalker, we supply each man with a printed form, Fig. 33. This form is headed "Linewalker's Inspection Report." The man is required to state on this form, in ink, every hour, his location in reference to his route number. He also states every location at which he makes a stop. Where streets or ditches are open, especially when other companies are opening streets, he makes a note what time he inspected this section. These records are checked up very carefully by the chief linewalker to be sure the dates and signatures are correct, and that no mistakes have been made. They are then filed for future use, in case they are needed.

All work, except that for which special rules are given, must be reported on a "Linewalker's Daily Report," Fig. 34, and turned into the office every evening. These report cards are small affairs, measuring 3 in. x 5 in., having blank spaces left for address, nature of work, by whom, dates of when started and completed, time inspected, service and main location, conditions found and ample space for remarks. Cases requiring prompt attention are immediately telephoned to the office and confirmed on the regular report card.

A separate report, complete in itself, is made covering conditions on each visit, while work is in progress. Especial attention is paid to the proximity to gas mains and services of other structures. When work is suspended, these visits are

FORM 308—P. O. W. 25C. 10-23-13

LINEWALKERS' INSPECTION REPORT

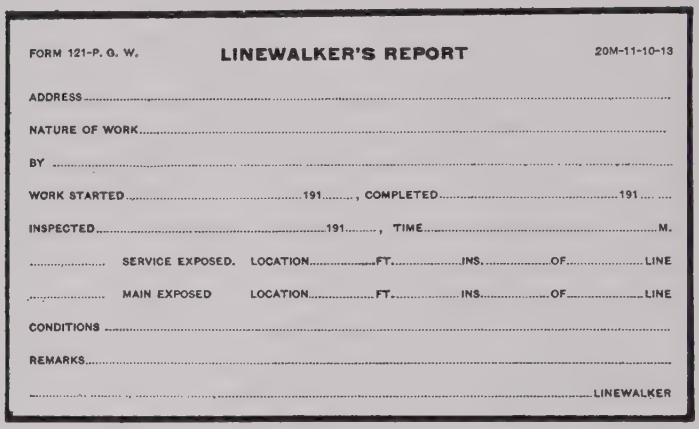
.....DISTRICT 191

STREET	FROM	TO

.....LINEWALKER

Fig. 33.—Linewalker's daily inspection report.

not made frequently. The last report is marked "Final." When an old gas main (that is to say, a main laid prior to the advent of our company) is exposed by another company, a



FORM 121-P. G. W. **LINEWALKER'S REPORT** 20M-11-10-13

ADDRESS.....

NATURE OF WORK.....

BY .....

WORK STARTED.....191....., COMPLETED.....191.....

INSPECTED.....191....., TIME.....M.

..... SERVICE EXPOSED. LOCATION.....FT.....INS.....OF.....LINE

..... MAIN EXPOSED LOCATION.....FT.....INS.....OF.....LINE

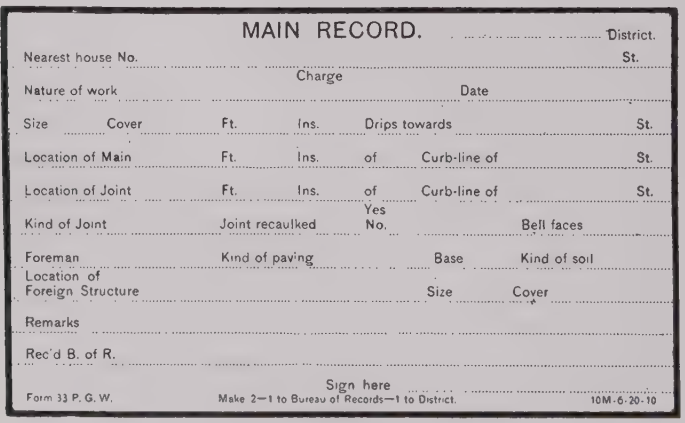
CONDITIONS .....

REMARKS.....

.....LINEWALKER

Fig. 34.—Linewalker's daily report.

report is made on what we call a "Street Main Record" card, Fig. 35, except when more than one consecutive joint on the



MAIN RECORD. ..... District.

Nearest house No. ..... St.

Charge

Nature of work ..... Date .....

Size ..... Cover ..... Ft. ..... Ins. ..... Drips towards ..... St.

Location of Main ..... Ft. ..... Ins. ..... of ..... Curb-line of ..... St.

Location of Joint ..... Ft. ..... Ins. ..... of ..... Curb-line of ..... St.

Yes

Kind of Joint ..... Joint recaulked ..... No. ..... Bell faces .....

Foreman ..... Kind of paving ..... Base ..... Kind of soil .....

Location of Foreign Structure ..... Size ..... Cover .....

Remarks .....

Rec'd B. of R. .....

Sign here .....

Form 33 P. G. W. Make 2—1 to Bureau of Records—1 to District. 10M-6-20-10

Fig. 35.—Street main record card.

same main, or a special casting, is exposed, or a complicated condition of foreign structure exists, in which case, the matter

is promptly referred to the office, using the telephone, if necessary, so that the necessary sketch record data can be obtained before the ditch is filled in. If a water main, sewer or conduit is exposed in the opening, the size, location and cover is reported on the "Street Main Record" card under "Remarks" or by a sketch on the back of the card. The "Street Main Record" card measures 3 in. x 5 in. and has blank spaces left for location of main and joints, cover of same, kind of joints, whether recaulked or not, location of foreign structure, kind of paving, etc., and, in general, gives a very good idea of the conditions of an opening in which our main is exposed.

When a report is made on a "Street Main Record" card, the following rules are observed.

(1) The card is made in duplicate by the use of carbon paper, so that the original card can be sent to the records division, and the duplicate card retained in the office.

(2) If no joint is exposed, a separate card is filled in for each section of exposed main, whether in the same trench or not—the center of the ditch to be considered the point at which the main is exposed.

(3) A separate card is made out for each joint exposed.

(4) Special attention is given to all the details as to location of all foreign structures.

(5) The number of feet of main exposed must be stated.

The above rules give us a very good history of an opening, which ofttimes comes in very handy in tracing back to other companies the responsibility of some trouble with our underground structures.

When a street is inspected, for which we have received notice that a main laying instruction has been issued, special effort is made to determine the exact conditions concerning the existence of curbs and underground structures. When no sewer exists, the proposed location is reported, if it is possible to obtain it from some one on the work. If the

instruction is marked "Application by Builder" the status of the operation is reported also, whether foundations are laid. houses completed, paving being laid, etc.

The linewalkers should be instructed to be on the lookout for any locations requiring signal lamps or flags, for which the company is responsible, such as dangerous ditches and new deliveries of gas pipe and specials. The report is made in time to permit lamps and flags being placed the same day, stating how many of each are required.

When the footway is being paved or repaved, investigation is made for service conditions; if service is in, whether renewal is necessary, new box wanted, etc.; if service is not in, it is the linewalker's duty to ascertain if it would be advisable to run one.

Special care is taken to report the progress of paving work on streets that have been released by the company. As soon as it is evident that such work is to be started, a report is sent in. The final report for each operation must contain, in addition to the location, the date completed, and the kind of paving. This gives us a very complete record of guaranteed streets, and we know immediately by looking up these cards, whether the guarantee has run out or not, or in other words, we know whether it is necessary to ask for permission to do work on these streets.

When the work on foundation walls of a new operation or building is far enough advanced to allow a service sleeve to be placed, a report to the office, is sent in. When the operation is ready for services to be run, this fact is also reported.

When a building is being altered or torn down, the service is located from some line that will not be changed, and investigation is made to see if the removal of the meter, or the abandoning or changing position of the service, is necessary. If the building being torn down is a large one, the portion of the building where the meter may be found, is stated on the card. Often, it is impossible to locate the service from outside of building; very often, it will be found that the con-

tractor has disconnected the meter, in which case, we locate it and have it taken to the shop. If we find the meter disconnected and in a dangerous location, it is moved to a safe

Fig. 36.—An 8-in. service showing flange connection.

place. Builders are cautioned against piling material over the street stop box, if the meter has not been removed.

When a vacant house is noticed, to which access might be had due to doors or windows being broken or open, it is re-

ported, giving the name and address of owner or agent, so that if a meter is in the house, it may be removed or steps taken to have these conditions remedied.

If the location of one or both curbs is changed due to the widening of the roadway, the matter is reported to the office, so the records division may be notified to change its records.

A report is made to the office immediately upon the discovery of a leak in a house or in the street. The name of the occupant or complainant and full particulars are reported. We impress upon our linewalkers the importance of dropping whatever else they may be doing until a reported or suspected leak is taken care of.

Each linewalker is responsible for the general condition of the district in his charge; he is frequently cautioned to bear in mind the welfare of the company and the public in regard to the prevention of accidents. Sunken ditches, cave-ins (no matter how small), high or low stop boxes, boxes without lids, exposed mains not properly protected by contractors, danger lamps not lighted or any other possible causes of an accident, are reported without delay.

Each linewalker is impressed with the importance of being familiar with our instructions, pertaining to street work details, paving and main and service administration.

It might be stated, in conclusion, that a linewalker performs a very valuable service to a gas company, and he should be a man of high calibre, both in general intelligence and in a knowledge of the company's rules.

Methods of Handling Leaks and Insufficients.

Leaks on Services.—In the treatment of leaks on services, we must, for the limit of space, confine ourselves to the handling of leaks already known or suspected to be outside of consumers' houses and, at the same time, apparently not along the line or lines of main in street or sidewalk. Without this limitation, the subject would necessarily include all the preliminary operations set forth under "Street Leak Work" for often the most difficult and dangereous street leaks frequently

develop into service leaks, As to whether the leak of gas is off the main in the immediate vicinity of the service or on the service in close proximity to the main, will be covered here.

Employees of the gas company, whether engaged in any other work or not, are expected to investigate immediately any leak, or alleged leak, that may in any manner, come to their attention.

On reaching the location of the leak, if for any reason an employee is unable to gain admittance and there is no odor of gas at the door or windows, he should consult the neighbors to learn, if possible, who is staying in the house and the probable time of such persons' return. He is warranted in going any reasonable distance for the purpose of finding a person who could admit him. If the address is too far away or he cannot obtain any definite information, he should telephone the office, where the question as to the advisability of taking further steps will be considered.

When there is an odor of gas coming from house through doors and windows or there is good reason to believe from odor of gas in an adacent cellar, that a like or stronger odor exists in the closed premises, he should shut gas off at service cock, seek a policeman, explain the case to him and urge upon him the advisability of forcing an entrance.

On gaining admittance, employee should be sure that any houses affected by the leak are being properly ventilated. When the odor is strong, ventilation should be as much from the outside as possible. Except in extreme cases, where there is absolute necessity to save life or property, no one should subject himself to the possibility of being overcome by gas.

The non-use of naked flames of any kind in any situation where there is an odor of gas is not a matter of judgment but of absolute obedience to orders. The electric torch or a safety lamp must furnish any light required. Leaks must be sought for by sense of smell or soap suds only.

In cases of emergency when leak is bad, stringent action as shutting off the gas, putting out lights, opening doors and

windows, ordering all occupants out of the house, or houses, and in calling policeman or passersby to assist, is justified. These matters are left entirely to the judgment of employee. The aim should be to adopt a safe course, under the circumstances, not unnecessarily alarming the occupants.

As to whether the leak is large or small, must be determined to the best of the ability of the man entrusted with the work. The policy followed is not to take any chances; if there is thought to be any danger from the escaping gas, a shut off and any or all of the above measures must be taken.

As we are dealing with leaks on services, it will be assumed that on investigation in cellar, the leak is found entering cellar through front cellar wall, drain pipe or conduit connection, either close to or remote from service. Any possibility that leak is on interior piping, fixtures, appliances, etc., is here purposely precluded. If odor of gas enters near or at partition wall or there is anything that would warrant believing the gas to be coming from or going into the adjoining premises, an examination should be made and occupant of such premises notified of any odor of gas present.

The escaping gas may be leaking from the service, somewhere along its length, from an abandoned or unrecorded lamp or house service, from main in street or sidewalk, either close by or many squares away, travelling by way of conduits and other structures.

By examining for and tracing the odor of gas at all such telltale points, as depressions in street, manholes (sewer, conduit, water, etc.) and stop boxes, by a judicious system of barring or drilling over mains and services, noting particularly any depressions over these, the leak is practically "run down" or approximately located. We will assume this work done and the leak so located at service.

An odor of gas at cellar wall only, with stop box at curb or house clear, would indicate a leakage on service between cock and house. By shutting service cock and noting whether in a short time the odor seems to be dying out at wall, we can,

if this proves to be the case, get a pretty sure indication that leak is on this part of service. Of course, a pocket of gas, or a travelling of the gas from a coexisting leak on a neighboring

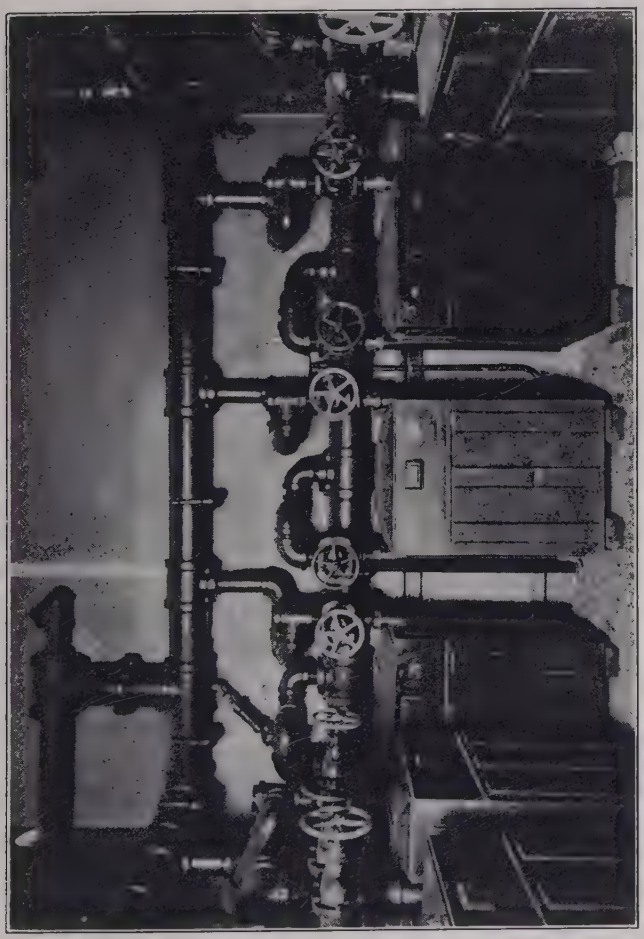


Fig. 37.—Method of running 8-in. service inside building where meters are set in parallel.

service, a leaking, abandoned or unaccounted for lamp service or other source, will sometimes render this method unavailing, and the immediate step taken must be left to a great extent to

the judgment of the man in charge. Judgment founded on experience in the innumerable, apparently insignificant, but nevertheless very pertinent, details, alone can conduce to the proper and economical handling of leaks.

When the sidewalk is of dirt or of the ordinary brick paving, barring or drilling over or close to the service, should be resorted to, but with cement, flag or other improved paving, especially under frozen conditions, such barring or drilling should be avoided or reduced to a minimum. Those bar holes not included in subsequent excavation, no matter how well cemented up will, unless repaving is done, be a constant source of irritation with the property owners or tenants.

If equipped with pressure gauge, an ordinary 6 in. water gauge will suffice; the use of these on head of service will show conclusively any leakage on service between cock and cellar wall. The gas is first shut off at service cock for installation of gauge, then with meter cock closed, a lung pressure equal to 6 in. water column shown on gauge is thrown on service and cock at gauge closed. Any drop in pressure in service as shown on gauge will be due to leakage from service. A careful examination for leaks, of all piping between service and the meter and gauge cock, as well as of the cocks themselves, must be made in all cases. Service cock can be taken as tight if, when first shut off, there is no accumulation of pressure in service with meter and gauge cock closed.

If there is an odor of gas at stop box, and the above test shows no drop in pressure, the leak, if on service, must be between cock and main. Barring or drilling over this portion of service and over main, close to service, will indicate the most probable place to open over service or main to locate the leak. A slight leak at service cock will often prove deceptive. The turning on or off of cock in manipulating, or the striking of cock while uncovering, will serve to stop a leakage temporarily and only a careful examination will again reveal it.

If the service is a recently laid service, and apparently in

good conditions, that portion only of the service supposed to be leaking need be opened over as a local condition such as bad ground, subsequent excavations, pick holes, electrolysis, etc., may have caused the leakage and if leak is found, a repair covering only damaged or leaking portion need be made. If service is an old one, while a hasty uncovering of the leaking portion for temporary repair is advisable, preparations for a complete renewal of service should be initiated. Partial renewals of old services have not proved advisable. Temporary repairs are made with tallowed muslin wrapped several times around service at location of leak and bound with string.

Where the leak on service is attributed to undue rusting or to electrolysis, either of several methods for protection to the renewed service can be adopted.

As provision against the chemical or rusting action the service may be surrounded for a space of one foot in all directions with a good clean clay or loam, encased in a trough of cement, grout or pitch, or given a double wrapping of muslin alternating with service pipe coating whereby the muslin becomes thoroughly saturated with the coating. The whole is then given a final covering of the service coating. The service cock, of course, is left free of wrapping or coating. Galvanized pipe is also used to withstand the corrosive action of soils. Electrolysis action is best reduced by one or other of the trough constructions. For further details of these precautionary methods, see "Service Laying."

When turning on after investigation, repair, renewal, etc., where gas has been shut off, precautions must be taken to see that no open outlets or leaks are left in the house piping.

All card orders and records of repairs, paving, etc., are given under the heading of "Recording."

Insufficients on Services.—The term "Insufficient on Service" covers all degrees of insufficiency from a very slight lowering of the pressure at peak load only, to a complete stoppage, and the method of handling such insufficients will

depend largely upon this degree of insufficiency as well as the nature of stoppage.

An insufficient affecting the entire supply to a system of

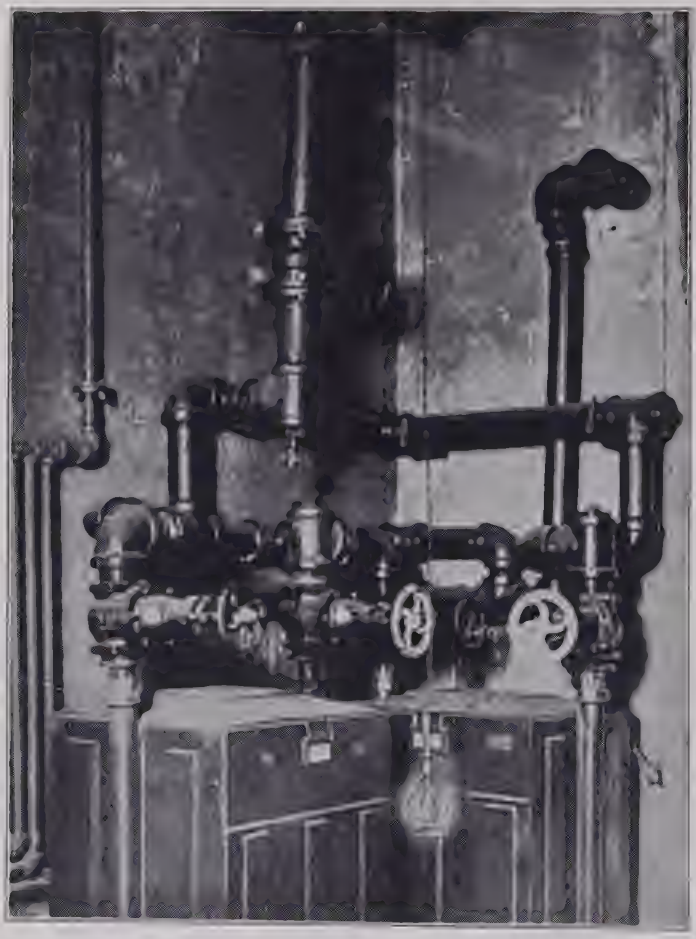


Fig. 38.—A 4-in. service with two meters set in parallel.

house piping must, of necessity, be located along the main source of supply, or for any particular premise, along riser,

meter, service or main. Other localized and, therefore, house pipe insufficients are taken care of by the fitting department.

The degree of insufficiency would determine the method of localizing a general insufficient. When there is some passage of gas beyond the stoppage, a lighting of burners or the use of pressure gauges, the unscrewing of a plug at the bottom of the riser, the disconnection of meter outlet and cracking open of meter valve, or the removal of plug at head of service will, without going into details, locate the stoppage within narrow limits.

No plug or cap, or piece of pipe larger than ⅜ in. should be removed unless there are, at least, two employees present. The unscrewing of the ⅜-in. pipe, however, should not be undertaken with gas on unless consumer objects to the shutting off at the time, and then only by taking all the precautions necessary.

Having traced the stoppage as above and found it still to exist after meter inlet is disconnected and meter cock cracked open, as well as upon the removal of plug at head of service, it is certain that stoppage is in service or in main supplying the service. Unless there are several complaints along the line of main, it is reasonable and economical to assume that the cause of insufficient lies in the service. Should the service be shown to be clear, and the insufficient still persist, we must conclude that the source of trouble is in the main, and an examination of pressure at neighboring services, lamp posts, drip pipes, pressure test pipes and, if necessary, a combination of bagging off and pressure tests, more appropriately given under main work, must be resorted to.

An insufficient at service may be due to the collection in a trap or sag of the service, of liquid condensation from the gas or of water leaking into service from without. It may be due to a rusting or disintegrating and consequent partial or complete stoppage with solid matter or to a combination of liquid and solid stoppage. A most prolific cause of insufficient is the "frozen" service. Here, whatever the stoppage

may be, it has contained sufficient liquid to freeze and the service may or may not be "blocked solid."

Again, the service may not be of sufficient size to supply the gas required. This should always be checked up when in doubt as to the cause of insufficient.

The accidental introduction of solid matter in the service at time of laying, imperfect service cock or the formation of naphthalene, while sources of insufficient supply, are of rare occurence.

A liquid stoppage, unless complete, will be denoted by a more or less rapid variation in pressure at the head of service while the gas is flowing. A solid stoppage, under similar conditions, though causing a reduction in pressure, gives none of the above rapid variations to the passing gas. A liquid total stoppage is distinguished from a similar solid stoppage in that the service wire meets with apparently no resistance in passing through it, and the wire on withdrawal, shows wet.

Liquid stoppages in a service, unless an unusual length of service is involved, or service is of large diameter, is readily removed with a few blasts from the force pump. An unusual length of trapped service if of small diameter, may be cleared temporarily, *i. e.*, the liquid will be more or less spread out over the inner surface of the service, but apart from a small portion evaporated by contact with the injected air or any possible unsaturated gas passing at the time, the liquid will again collect at the trap. In such cases it becomes necessary to uncover the service over, and for some distance on each side of, the trap and endeavor to straighten out or drip the service properly. The location of trap, if service is devoid of bends, can be approximated to by the insertion and withdrawal of a wire until the end shows wet. Cutting the service, inserting a drip, or an encircling construction, should only be resorted to when the above method is impracticable, owing to improved paving or other costly construction.

It is not practicable with the force pumps used, to "blow out" a service of large diameter, even though the length of

service may be short. Uncovering and redripping or cutting and encircling or inserting drip, is the practice followed in such cases.

When, owing to the remoteness of stoppages, the volume of air discharged by the force pump, will not carry under sufficient pressure to remove the obstruction, and being without gas, subjects the consumer to great hardship, the time required for the uncovering of the service necessarily prolonging such hardship, if the service is apparently in sound condition, temporary relief, at least, may be obtained by connecting the pump to the service and treating the combination as a reservoir, the cock of service serving as cock of the combined reservoir. The meter cock must be closed whenever pressure is applied to the service, and, in the above case, as an extra precaution, the meter inlet coupling should be disconnected. The above method is only to be undertaken in extreme cases and must be followed by a 6 in. water pressure test on service and a thorough smelling at stop box for any leak started.

Solid stoppages, other than "freeze ups" require in addition to the force pump, a wiring of the service. This wiring, except when the stoppage is very slight, should always precede pumping, the object being to first loosen the obstruction with the wire and then remove it with the pump. With solid stoppages as with liquid, in cases of emergency, the pump and service can be used as a common reservoir.

When solid stoppages cannot be cleared, service must be dug up over stoppage and the latter removed. The same precautions as given under liquid stoppages must be taken with solid stoppages.

Frozen stoppages in addition to being wired and pumped, are treated with a solvent liquid as wood alcohol, hot water (salty), etc. The action of these liquids is to dissolve more or less of the frozen or icy particles of the obstruction and, provided the latter is not too extended, to so soften or disintegrate the obstructing mass that it becomes amenable to wire and pump. Often, when the frozen stoppage is not complete,

a little alcohol poured into the service, suffices to clear it and the complaint man, unprovided with wire and pump, closes meter cock, disconnects meter inlet connection, pours sufficient liquid into the inverted connection and cracks open the meter cock to allow the liquid to pass through meter inlet piping into service.

When the obstruction is complete and obdurate, the complaint man introduces the alcohol as above, connects meter and meter connection, sees that meter cock is closed and telephones conditions to the office so that a man or men with wire and pump may follow. It is possible and even probable, that the alcohol in the meantime may act on the stoppage so that it may easily be removed or may have disappeared entirely when second man or men arrive with the pump.

When the service is "frozen solid" for a considerable portion of its length, it sometimes becomes impracticable to remove obstruction from within and service must be dug up and thawed out. In extreme cases, under great urgency, when the frozen service is particularly difficult to clear, resort must be had to the special method of treatment under liquid and solid stoppages.

For all solid stoppages, whether frozen or not, another very successful method of clearing is with the drip or suction pump and water. The water should be salty if for frozen stoppage. The suction pump is screwed to the head of the service. The service is filled with the salty water and the pump primed. Then by applying suction on the service, only the most stubborn stoppage will resist removal. Whatever is removed from the service must be caught in a suitable vessel and not allowed to fall on cellar floor.

There are certain precautions to be observed when working on service insufficients. Whenever pressure or suction is thrown upon a service, the meter cock must be closed. When any old service has been wired or pumped, a pressure test of 6 in. of water pressure, as shown on gauge, should be applied

to the service and stop box must be thoroughly examined for odor of gas.

Service and pump may be made a common reservoir only when service is in good condition. A test with 6 in. of water pressure, and the smelling at stop box must be made in all these cases. Where the size of main is not such that the volume of gas contained in close proximity to service is not large, relatively, to that of the compressed air in combined service and pump, when expanded to ordinary gas pressure, the possibility of such air affecting the burning of the gas must be borne in mind. Attaching a hose to head of service and conducting the escaping mixture into the open air outside of the premises, will, in most cases, where there is but slight flow within the main, sufficiently clear the main and service of air. Lighting burners in adjacent premises, close to this service, and waiting until any "blowing" or failure to ignite at these burners ceases, will also suffice to sufficiently clear main and service of the air and gas mixture. Salty water is always preferable to clear water when working in frozen ground.

The work of clearing a service by pump, wire, introduction of wood alcohol or salty water should never be done by one man alone without the use of one of the standard safety devices which permit of the gas being turned off at any stage of the process, by means of a cock, as distinguished from the making of a service joint (see sketch of Safety Service Cleaning Device, Fig. 17).

The wiring of a service requires the presence of two employees, unless Safety Service Cleaning Device is used. The avoidance of fire and the danger of explosion must never be overlooked.

Stop Box Inspection.

The top of stop boxes, which should be just level with, but which often project above, the surface of surrounding paving, due to the settlement of paving and the action of frost in raising boxes, make constant supervision necessary, especially in congested districts where traffic is heavy and pedestrians

numerous. These projecting boxes form obstacles which are the fruitful source of many damage suits against the gas company.

Where an efficient system of linewalking is maintained, these high boxes are easily detected. However, this constant watchfulness should be supplemented by a general examination of all stop boxes, at least, once a year. The results of such examination should be given to the service department and often those only a trifle high may be remedied by a blow from some heavy object, such as a dirt rammer, while those which do not respond to this treatment, should have the top screwed down to the required level.

The stop box often becomes stopped up with dirt or other foreign substances which do not allow the cock to be reached. Such stop boxes should be cleared out by a man equipped with the necessary tools in the shape of long spoonlike cleaners.

Valve and Stop Cock Inspection.

The stop cock, when proper precautions have not been taken in its installation, becomes stiff or set so that it cannot be turned. Often this trouble may be remedied by digging up and easing the barrel, by turning it quickly with a wrench. When the cock shows further defects, it should be replaced by a perfect one. No greasing of the barrel should be allowed in the ditch. It is well to have a yearly inspection of cocks, especially 2 in. and over, in order to care for the above conditions.

All valves should be inspected yearly, as it frequently occurs that trouble is found in them also. The gates very often stick and will not drop, and many other minor troubles occur that very often terminate seriously if not remedied.

Trouble with Foreign Companies, Structures.

Large excavations, such as are made for large sewers, etc., often expose services in dangerous positions. Practice has shown it best to detail a competent man to thoroughly test

them for possible leakage and see that they are properly blocked up when the ditch is back-filled. Those which show any signs of deterioration should be renewed to avoid danger of further leakage, to locate which, may require breaking of large amounts of paving.

Mr. Duncan: (First reading a synopsis of his paper.) In Fig. 13 is shown a spoon bar used as a stop box cleaner. Since writing the paper, another device has been brought to my attention, which seems to be a big improvement over the spoon bar. In order to better describe this idea, I have made a model of the new stop box cleaner, which can be examined by anybody interested. We have not as yet made any of these tools, as we first wish to determine whether or not the article is patented. Its construction is simply that of an adjustable scoop at the end of 6 ft. of ⅜-in. pipe. The scoop is controlled from the top of the cleaner through a rod and spring running to the bottom. This little device will, no doubt, save from 50 to 75 per cent. of the time now taken in cleaning stop boxes.

The Chairman: Gentlemen, you have heard Mr. Duncan's abstract. I am only sorry you could not hear his paper, because it certainly is a treatise on a subject that every distribution man has to do with. Therefore, the discussion should be of interest to everybody, and I hope it will be most complete.

Mr. D. E. Keppelmann (San Francisco): I want to ask Mr. Duncan who determines the location of the service? If his answer is that the company does, then I wish to elaborate on my question, taking into consideration the companies who serve not only gas but electricity as well; also some companies where there is no competition with gas and where there is all kinds of competition with electricity. Assuming a building where you are about to install both gas and electricity, knowing the prospective consumer, builder or owner will be a con-

sumer to the extent of about $50, $60 or $100 a month, I want to ask him, do you, as a department, make that location stick?

THE CHAIRMAN: Are there any other questions or other discussions?

MR. C. C. SIMPSON (New York): Mr. Duncan has read a most admirable paper, which I cannot discuss very fully or question to any great length, for the reason that his practice in service work is almost identical with our own.

There are, however, a few points on which we differ, and on these points I would like to ask Mr. Duncan a few questions. Mr. Duncan fails to mention a very troublesome feature in the gas business in northern latitudes—frozen services. In New York, we are always glad to learn something new in this connection, and if The United Gas Improvement Company has any information on this subject which is not in our possession, we should be glad to receive it, and we also should be glad to impart any information that we have. New York is a little further north than Philadelphia, but hardly far enough to make a difference in the number of frozen services, granting that other conditions are equal. Of course, we have a much greater number of apartment houses, which will probably make quite a difference in the ultimate result.

In New York, we lay no services smaller than 1½ in., and, therefore, do not use stop-cocks. I would not, however, be inclined to use stop-cocks on services even under 1½ in. in diameter. Our experience with these has been, that, when used once or twice, they stick, and when they stick they are useless and have to be dug up. When you want a service shut off, that is the only thing you do want at that particular time, and it is rather embarassing to learn that the stop-cock will not move. We use valves exclusively.

On Manhattan Island, we have several hundred miles of wrought iron mains, laid about 26 years ago. These mains are in perfect condition to-day. That is our experience with wrought iron. When steel was first introduced, we followed the general trend of buying cheaper material, and used steel

for services. Many of these steel services have rusted out since, and probably some of the older wrought iron services have rusted out also, though as the latter were of small diameter, most of them have been removed for insufficiency. Unfortunately, no particular attention was paid to their physical condition when removed.

On this question of wrought iron versus steel, I have recently read a report of a test of various types of plates such as would be rolled into pipe,—though these particular plates were not made up for pipe—made by an independent metallurgical expert. He placed open-hearth copper steel at the top of the list in reference to the relative resistance to corrosion, followed by wrought iron and then by Bessemer steel, from which steel pipe is made.

Mr. Duncan speaks of coating service pipe with the Hickenlooper mixture. Several years ago, we had some tests made of every known mixture, paint, or dip that was at that time on the market, for coating pipe, and were sorry to learn at that time that not one of those tested was of much value, but the one that appeared to give far better results than any of the others, was red lead. We, therefore, use a red lead mixture for coating our pipe, and have been able to coat 1¼-in. pipe by spraying this mixture, for 0.2 of a cent per foot, labor and material, which is slightly lower than Mr. Duncan's figure.

I would like to ask Mr. Duncan what he considers to be the average life of a service. I think that this is a very important point which has never been brought up. What is the average life of a service in Philadelphia or in any other town? Is it 10 years, 20 years, 30 years, 40 years, or what is it? Mr. Duncan may not be able to answer, though I hope he can.

Mr. Duncan speaks of linewalkers, and then he stops them walking and mounts them on bicycles. In New York, we have linewalkers, or patrolmen. We require them to walk. The reason we differ with Mr. Duncan in this respect is, that we do not want the ground covered too quickly. The things these

men are looking for are not the big, startling features, but are the small details that would escape an ordinary man going through the street. You can smell a leak on a bicycle, but you are more likely to detect it if you are walking; and if the patrolmen—as do ours—walk near the curb, they will detect leaks on both mains and services. Mr. Duncan's bicycle patrolmen will detect depressions in the pavement more readily than our men because they will come in physical contact with them on their bicycles.

In conclusion, I beg to state that except for a very few minor points of departure, it would be possible for us to use Mr. Duncan's paper as the standard for our work.

Mr. W. F. Croston (Newport News, Va.): We have found it advantageous to cut out the use of wrought iron pipe in Newport News. A great many of our services which have been in from six to seven years are completely rusted out. This is due, no doubt, to our unusual location. Our city is, on the average, about 5 ft. above sea level, and in most places you can strike water by digging 2 ft. The salt water is naturally very hard on the service pipe. For that reason, we have taken to galvanized pipe entirely. I also want to ask what is the policy in regard to services. Due to our location, there are no cellars, and the meters are all placed in the kitchens. The services naturally have to extend to the back end of the house. If a house is a two-story one, with a family upstairs, is the service extended to the second floor at the expense of the company, or is it extended at the expense of the householder?

I would also like to know if any companies are using as service cleaners, those wire arrangements the plumbers use, a wire spring which they twist around to take the rust out of the inside of the pipe.

Mr. Charles Wilde (Chester, Pa.): Mr. Duncan has, to my mind, very thoroughly covered the subject of service installation and maintenance, and has brought out the necessary steps in service work, in a manner that makes this work very clear to the reader. There are, however, two or three points

brought out with which I cannot thoroughly agree. In connection with the subject "Installation in Advance of Paving," page 1057, Mr. Duncan points out the doubtful advantages gained by extending the service to the curb in advance of paving. In this, I believe all who have had any experience with the disagreeable conditions resulting from this practice, will agree. In the second paragraph of this subject, however, this suggestion is given "When one side of a street is built up before paving, by laying the main on the opposite side, you will run your long services before paving, leaving only short ones to be installed. Should your paving go down before being compelled to run the short services, only a small amount of paving is involved." I do not believe this would be a good rule to follow. If this were attempted, it would probably necessitate very frequent changes of the location of the main from one side of the street to the other, which would be a very bad practice. The main should be maintained, as near as possible, to a straight line throughout the length of the street from block to block.

In the subject "Location Details," beginning with the ninth line on page 1059, the writer says "Where no opening has been provided, it should be placed under cellar windows or under steps." I do not believe that a location under a cellar window is a good place for a service. A service thus located would run a great risk of being broken by any heavy material thrown in the window, and it would also require the connection from the service to the meter to be off-set in order to keep the window clear of obstructions; otherwise, the pipe would interfere with the free passage of the window and would thus be objectionable to the occupant of the house. If the opening required for a service is properly repaired, the wall will not be any weaker as a result of the service pipe passing through it.

Referring to the subject "Valve and Stop Cocks" on page 1062, I believe most gas engineers will agree with the author, that curb cocks are of little value. I would suggest in this connection, that a cock be placed inside the cellar wall, ahead of

the tee, and dispense with the regular meter cock. This arrangement would do away with one cock, it would remove the necessity of a fitter having to make connections with gas on, and would, when a locking device is used, go a long way in preventing any gas stealing from an idle service. This arrangement would only apply, however, when the service was properly located in relation to the meter, as it will be realized that a cock should always be provided near the meter.

Mr. J. W. Batten (Detroit): I have a few general observations in regard to this paper by Mr. Duncan. I might say with Mr. Simpson, that our operation in Detroit is so reasonably near that of Philadelphia, that there is very little criticism to offer

This paper by Mr. Duncan, I need not say, is a very valuable contribution to the published information on the subject. It is no theoretical diquisition made in the office chair of the superintendent of distribution, but shows abundant evidence, as it should, of a great deal of thought, and thought crystallized into action.

The question of the proper size of ordinary house services is one upon which there is very considerable difference of opinion. If service piping could be depended upon to be invariably, or even usually, free from deposits, the question could be readily answered by the use of a smaller size service than is now usually the rule. In Detroit, where 1½-in. services have been used for a number of years, it is our experience that smaller services yield more complaints, resulting more frequently from partial stoppage than from deficient carrying capacity if clear. The distribution of a water gas of a relatively high gravity may also be a factor in determining a minimum size. In the case cited of a dwelling of twelve rooms, it would not appear the part of wisdom to install a 1¼-in. service, as possible demand made by water heaters, incinerators, room heaters, refrigerators, and the like, would undoubtedly cut into the supply very materially.

The minimum of 15-in. cover given for services would

scarcely be permitted in any city where danger from frost would be expected. The depth of the service should normally be kept as great as the depth of the main will allow. A minimum of 27 in. should be maintained wherever possible.

I believe no sound argument can be advanced for installation of curb cocks on small services. The consensus of experience is that the theoretical value of such a curb cock, *viz.*, the ability to shut off the gas in case of fire, is only a theoretical one, and that the box is covered with ice, snow or earth, or the stop cock has become so corroded through lack of use that it cannot be turned.

The tamping machine is of undoubted advantage in the conditions stated where water cannot be used. We have found that no amount of hand tamping is as effective as the use of water in a trench. The latter is, additionally, much less expensive.

There is considerable question as to the economy of driving or attempting to drive a service. The number of failures noted, even with experienced foremen, make it an expedient of doubtful value. There are, however, some conditions where it would be very difficult to install a service if driving were not resorted to. Such a case would be that, where the main is back of the curb, as it usually is with us, and where the service is to be installed to supply a consumer across a street paved with heavily reinforced concrete. The difficulty of making the cut and doing a satisfactory job of repaving is obvious.

Mr. F. N. Speller (Pittsburgh): It may be up to me to explain to Mr. Simpson why I would dissent to his argument with regard to wrought iron, although that question is pretty nearly closed now. Isolated cases may be found which show up favorably for the steel as well as for wrought iron. The environment or protective coatings are responsible for such satisfactory results. It is common experience that corrosion affects a small percentage of the underground pipe in any locality; less than 10 per cent. is usually subject to corrosion.

Therefore, to get a true comparison, we evidently must be careful that both materials were in use under the same conditions. It is under such conditions that the investigations have been made which have led to the conclusion that there is no practical difference between the durability of wrought iron and steel.

My investigations on this subject cover the past 10 years, and soon led to the conclusion that uniformity should be the keynote for the manufacturer of pipe where durability was desired. I do not refer to any particular operation designed to this end, but at every stage of manufacture, this object should, and is, kept uppermost by the leading manufacturer of pipe, so far as it is practicable to do so. The result is a much more uniform, corrosion resisting pipe to-day than we had several years ago, which, no doubt, has had much to do with changing the sentiment in favor of steel pipe.

Mr. Walton Forstall (Philadelphia): I believe that this paper is one which should be handed to everybody engaged in service work, and that it would prove of especial value to beginners in this branch. In connection with what is stated on pages 1067 and 1075 about the use of galvanized pipe, I would like to say that Philadelphia is now using this pipe experimentally where bad soil is encountered. Previously, the protection adopted was cement in a trough, and later on, pitch in a trough, but now we believe that the chances for long life with plain galvanized pipe are sufficient to warrant using it, at least for a time.

The service valve mentioned on page 1076, shown in Fig. 6, was until recently an all-iron, double gate valve. A few months ago, however, we discovered some valve stems which showed signs of corrosion, and, therefore, we are now using a bronze stem.

The statement on page 1076, about the corrosion of the service pipe where it is in contact with a wooden block, is based on instances observed by me somewhat over a year ago, during an inspection of thirty odd services laid 10 years previously.

While only a few instances of this deterioration were noticed, yet in each case the corrosion of the pipe was so much greater where it came in contact with the blocking, than where it lay on the ground, that we have deemed it wise to creosote all service blocking in future.

The frozen service problem, fortunately, is entirely absent from Philadelphia, simply because we have practically no cases where our service pipe is not underground. In New York City and in Chicago, there are many services more or less exposed to atmospheric temperatures where they pass through vaults and areaways. In Philadelphia, we have no trouble from frozen services at the minimum service depth of 15 in. The average depth would be 19 or 20 in.

As far as service life is concerned, nobody knows much about the life of wrought iron or steel service under good conditions. In 1898, we started a chronological record of all our services, because after 30 or 40 years all of the services might commence to give way and our successors would have a chance, after discovering the critical age, to know what services were approaching that stage. We have not got to that time yet. All we know about Philadelphia is that at intervals of 5 years, 1903, 1908 and 1913, we have selected thirty or forty services laid in 1898, and uncovered them at the curb. We have taken for the purpose of economy, and also as a severe test, locations under cobblestone pavement with a gravel and sand base and uncovered 2 or 3 ft. These thirty or forty examples have shown at the end of 15 years that in most cases there is still a suspicion of the tar coating. That does not necessarily prove the coating is worth much. We have good soil in Philadelphia, and it has taken 10 or 15 years for corrosion to begin to show in the pipe. How much longer our pipe is going to last, we do not know. That has a bearing on steel pipe. We have been using steel pipe since 1906, and the investigation in 1913 of steel pipe laid in 1906, as against wrought iron pipe laid in 1905 showed, if anything, a little bit in favor of the steel. But again, both the steel and wrought

iron have been exposed to the earth for only a year or two, as prior to that time, the tar coating has protected the metal. If we can buy the steel very much cheaper than the wrought iron, and it takes 14 or 15 years before the soil gets a chance to do anything, the argument seems to be in favor of steel.

Mr. H. B. Hoyt (Jacksonville, Fla.): I would like to ask Mr. Duncan if he has a very large percentage of losses of curb boxes in Philadelphia due to sidewalk paving. I would also like to know in what manner he keeps track of them; whether he is notified of the improvement in each case or whether the landlord takes care of that.

Mr. H. W. Terry (Ossining, N. Y.): In regard to the life of pipe, we took up some 3 and 4 in. services some time ago, and, at the best estimate, they had been in the ground about 40 years, and that pipe seemed to be in good condition, inside and out, very little corrosion, inside or outside, but the ground is very favorable.

The Chairman: What kind of pipe?

Mr. Terry: Wrought iron.

Mr. G. I. Vincent (Des Moines): I would like to make a few comments on Mr. Duncan's paper, but before that, I would like to say a word about frozen services. If, in our territory, we had frozen services only where the services were exposed, we would have very little difficulty. Our frozen services are under ground, and on account of our climate, the services have been well covered. We also would like to know some way to get around the difficulty. We have tried the injection of alcohol vapor at the works outlet (which we can do in a plant of our size) without any particular success, that is, nothing we have been able to note.

Mr. Duncan speaks of the inspection of services. We have developed that rather further, I believe, than most plants. Our inspector not only has charge of his service gang, but pre-inspects the work before the material is delivered. We operate in a very widely scattered territory, having only about 100 active services per mile of main. This one inspector not

only looks after those gangs, but pre-inspects the work, and if there are other installations to be made in addition to the service, as, for example, in an old residence where there are appliances and a meter, he also pre-inspects those at the same time. Thus, all the material can be made ready in the shop and one delivery is made for the whole installation. That is partly made possible by the use of small service gangs, and by the carts being permanently located in various sections of the city. For five service gangs, we have fourteen carts and expect to increase that to eighteen. These carts are light, and designed expressly for the work. The service men also do some inside work, but usually only in emergency. The carts are so light that they can be moved by hand by the gangs even on unpaved streets that are not too muddy. Each service gang consists of three men, or four if there are a number of services in one neighborhood to be put in.

In regard to drilling or driving pipe, I think that is largely determined by local conditions. In our service installation work, about 75 per cent. of the services are partly drilled. That is simply because the soil is a loamy clay in which it is perfectly possible to drill, and we can run holes with an ordinary auger with a long feeding point, for comparatively long distances. Twenty-five feet can be accomplished without any difficulty. That saves not only tearing up the pavement, but also the sod, and where a man has a nice residence and a well sodded lawn, he naturally objects to having the sod torn up. By making holes at intervals, and drilling the space between, we can save removing most of the sod on long services.

As far as driving pipe is concerned, we have had no experience, but personally I do not think I would care to advocate it.

In regard to the relative value of wrought iron and steel, I agree with Mr. Forstall that I do not think we know very fuch about it. I do not think any data advanced, that a man had dug up a piece of wrought iron pipe that has been

buried for 25 or 30 years, as we have, and found it in perfectly good order, is any particular criterion, because I have dug up wrought iron pipe that was buried only six months, and there was very little of it left. It was simply a function of the soil in which the pipe was buried, or subsequent changes to the soil. In Mr. Duncan's paper, he advocates laying a service in a bad soil, in boxes filled with either pitch or cement, expressing a preference for pitch. I think the objection to use of cement is that it has not been properly installed. Personally, I think cement is the better of the two, because it is possible to readily disburb a pitch covered service, when underground work is done by other companies, while we would expect a properly laid cement coating to be very much stronger.

Mr. Simpson: Mr. Chairman, if I may speak again on the question of wrought iron versus steel, I would say that I probably did not make myself clear with respect to the 200 odd miles of pipe which I mentioned before. That pipe belonged to the Standard Gas Light Company, which is a company affiliated with the Consolidated Company, and all of the pipe is wrought iron—there is not one foot of steel. This 200 miles of pipe has been uncovered in many thousand different places in recent years, and the pipe, as far as we can see, is in perfect condition, and I think in New York, on account of the great amount of excavation, we probably have more opportunity to examine our underground structures than in any other city. Our superintendents have been instructed for years to report any case of Standard wrought iron main in anything but perfect shape, and to date we have received but two reports of this kind, and in both cases the pipe was evidently damaged and not corroded. I am not trying to hurt the sale of steel pipe, nor am I by any means wedded to the use of wrought iron, but we in New York—and New York is all we are interested in when we are buynig pipe for New York—having this example before us, must in the light of our present knowledge act accordingly.

Another point with reference to frozen services, on which we seem to have been unable to obtain much light. We are not sleeping on this question in New York. Every winter or spring we freeze up artificially a number of services and watch them, and endeavor to learn everything possible about their behavior. Last year we found out another weak spot. On most services there is a valve, protected by an ordinary curb box of about 4 in. inside diameter, which provides an air space around the valve, if the box has not been accidentally filled up. If the air outside is in the neighborhood of zero, this is also the temperature of the air in the service box and around the valve. We reproduced these conditions artifically, and found that the valves did freeze up, and that this was one of our sources of trouble with frozen services. We are now covering the valves, before placing the box, with asbestos cement. This has worked all right experimentally in a brine solution at a temperature of 2 or 3 degrees below zero, and should work out in practice. The cost of covering valves in this way is very small. Some of our northern neighbors may be glad to know this.

Mr. Speller: Mr. Simpson, will you quote that interesting case you were speaking of?

Mr. Simpson: I cannot say—I was not actively in the gas business at the time these mains were laid. At the present time, they show absolutely no signs of corrosion; merely the ordinary surface rust like the outside of cast iron pipe.

Mr. Speller: Referring again to Mr. Simpson's description of the large wrought iron main which has evidently given much satisfaction, there would be nothing left to be said if this was anything more than a very conspicuous example of wrought iron which has been very fortunate in its preservation. It would be useful to know what protective coating was used and how it was applied to this pipe.

I have always discouraged the use of such isolated cases as evidence as to the durability of any material. As a matter of interest, however, I might refer to one case of a 16-in. steel

gas main laid in Southwestern Pennsylvania in 1895. It recently became necessary to renew the joints, which were leaking, and 45 miles of this pipe were dug up. The pipe had not been protected by any coating; nevertheless, it showed scarcely any corrosion after more than 18 years service, and every length was re-laid with new joints in the same ditch. One of the men on the job remarked that, "This steel would evidently last forever," but I am not asking you to accept his conclusion. This is simply mentioned by way of showing that you can prove anything for any material by such evidence.

Mr. Keppelmann: We do not have any winters in California, consequently, know nothing about frozen services. I would like to ask Mr. Duncan and Mr. Forstall what they are doing with electrolysis. Do you have an organized force investigating to prevent electrolysis, or do you take care of it after you find it?

Mr. T. R. Sucher (New Haven): I want to ask Mr. Duncan if he can inform me whether they are using automatic gas cut-offs? By that I mean, a gas cut-off that works automatically when affected by heat? Also, are they using a gas cut-off installed in the cellar, operated from the outside of the building by means of a cable?

Mr. Joseph Lucena (Omaha, Neb.): This discussion attempts to cover only a few points which may bring out further light on the subject covered.

Under "Conditions Affecting Size of Service" it is stated: "For larger towns and cities 1¼-in. would seem very much more desirable." This is undoubtedly true in the main, but in the newer large cities in some sections of the country, particularly where much electricity is used for lighting purposes in residences, a 1-in. service will suffice in dwellings of six rooms or less, of which a surprisingly large number are built.

When it is considered that about 50 per cent. of the new dwellings are of six rooms or under, quite a tidy saving is made by installing 1-in. services. Any possibility of increased consumpton, due to future house heating with gas, need not be

considered alarming to those who would use a 1-in. minimum service, as a slight increase in main pressures would give the necessary increase in service capacity.

With the exception noted with reference to 1-in. services, Omaha follows the same schedule as given in the paper.

Service Drips.—In Omaha service drips are invariably placed outside of the buildings, using the same type of drip as shown in the paper, believing that in the interests of safety, a service drip should under no circumstances be placed indoors.

Valve and Stop Cocks.—The use of these is a constant source of annoyance and expense, and could profitably be discontinued, except on large services. It is found the exception, rather than the rule, that cocks are accessible when needed, this condition being due principally to their being located in unpaved parkings, although where located in paving, they are often in the same useless condition.

Transportation—Service Carts.—Weight is an element in carts drawn by men from job to job, and a reduction of weight, it is said, may be obtained by substituting metal for wood in the construction of service carts without sacrificing strength. Carts of this description are in satisfactory use.

Drilling or Driving.—Services are occasionally drilled for, but except in filled ground, gravel, rock or other soil in which any form of laying a service would be next to impossible except by trenching, a pipe pushing machine of proper design is more satisfactory than drilling or driving. In good clay soil, it is usually possible to push up to 100 ft. of 1-in. to 2-in. pipe with little danger of the pipe being trapped or missing direction. The coating on the pipe is not appreciably injured. Pipe pushing may be done with a pick as an anchor for the bar used as a lever against two Stillson wrenches held on the pipe as a grip, the pipe being turned more or less continuously to keep it going straight. This is not the best method of pushing pipe, as machines are now obtainable which do the work far better and with less injury to the pipe coating.

Mr. F. W. Sargeant (Indianapolis): We have found it necessary in using stop cocks on services, 2-in. or smaller, to rid ourselves of the many evils you encounter with the ordinary stock material. We had made up a special pattern in which the body is heavier and the core is of a more conical shape than you would find in the regular manufactured stop cock. By doing this, we are able to rid ourselves of the most common complaint of locking the core. We also had the head on the key made heavier.

We are using a style of stop-box that contains a lug at the base or bell and sets directly on the head of the service cock, which fits neatly inside of the lower portion of base of the stop-box. This construction is such that in using the key for operation there is no time lost, as the space is so small that the key readily finds the slot cut in the lug. With this style of stop-box, there is no shifting and no chance to set it in any position except absolutely the center of the stop cock. There is a gland attached to the top of the lower or base section, which permits the entrance of 1-in. pipe, and by this arrangement, you are able to adjust the stop-box to any depth desired. The top, which contains the regular ¾-in. pipe plug with pentagon head for the entrance of the key, is attached to the 1-in. pipe with standard pipe thread. In using this style of stop-box, we have rid ourselves of the many evils experienced with the old type of two-piece Buffalo curb box; it being of special arrangement, makes it absolutely "foolproof."

In repairing leaks on services, also mains, we have found it a great deal better to use electrician's tape in width from 3 to 5 in. By using this tape, the gas leak can be mastered much quicker and with more certainty than with the use of soap and muslin.

Mr. J. A. Gould (Boston): I wish to speak on only a few items mentioned in this paper. Referring to the size of service pipes. In Boston the minimum size of service pipe has been 1½ in. for about 25 years. This diameter was adopted instead of 1¼ in., principally because that was the smallest pipe made

with lap joints, but aside from that, a 1½ in. is superior to 1¼ in. as its capacity is about 60 per cent. more, its cost only 20 per cent. more or 1.4 cents per foot, and is less liable to stoppages by frost.

Referring to sidewalk valves or cocks, we do not place sidewalk shut-offs on pipes smaller than 2½ in., but we do place cocks or valves on all services inside the cellar wall. The demand of certain interested parties, that sidewalk cocks be placed on all services, is unreasonable, as we find by experience that emergency work, such as fires, can be more quickly handled by use of inside valves or cocks. This applies more especially to companies located in the northern section where the valve boxes are liable to be covered by snow and ice during the winter months, and valuable time is lost in locating and operating the valves. The author questions the necessity for the general use of these outside shut-offs, and I agree with him decidedly.

Whether we should use wrought iron or steel pipes continues to be a question for discussion. Steel pipe may be as good as wrought iron, but until we are sure it is better, we see no good reason for changing. The trifling difference in cost is of small moment compared to the doubt many of us have as to the durability of steel in the various soils we find in streets adjacent to salt water. The cost of the pipe is the least item of cost of a service pipe in city streets. One good thing about this agitation by the steel men—it keeps the wrought iron men on their job, and we benefit by it.

We continue to paint our pipes with red lead tempered with a small amount of white lead.

In our case, it seems a waste of energy to maintain a force of skilled men to systematically patrol the streets twice a week, as is done in Philadelphia, or daily, as in another large city. We have a daily record of all permits received by the city for all street openings, which our inspectors follow up. This concentrates inspection where it is most needed. Then the daily travels of the main and service men, jobbers, solicitors, meter readers and collectors, as well as the superintendent and

general foremen, make a practical inspection of all our pipe routes at frequent intervals while on their regular work. Then we have the whole police force and three-quarters of a million people who enjoy reporting any odor that in any way resembles escaping gas.

THE CHAIRMAN: Gentlemen, if there is no further discussion, Mr. Duncan will close his paper, after which we will have the exhibits of thermit welding.

MR. DUNCAN: In answering Mr. Keppelman's question on who determines the location of the service, I might state that just recently the U. G. I. Co. has put into vogue a new practice in Philadelphia that I will endeavor to describe:

The old practice was simply a mutual agreement between the architect and our service foreman, on large buildings, and the builder or contractor, on operation work. Much time was wasted, especially by the service foreman, in endeavoring to get in touch with the desired parties, and even after a verbal permission, we had no evidence to prove the right to our location. This was especially unfortunate in large buildings, very often other companies using our sleeve left in the foundation well, and compelling us to take another location, causing added expense in cutting through foundation wall (as a rule, concrete from 2 to 3 ft. in width).

The new scheme provides a form for the architect and builder to sign giving us their desired locations. On examining their location, should our main be so located to enable us to grant the position desired by them, we notify them of our approval; however, should our main be so located that we are unable to conform to their wishes, a letter is written, giving our main location and asking them to decide on another position. Of course, we also take into consideration the location of meters when deciding on the proper place to install service.

This new scheme has been working out remarkably well, and we always have on hand the signed statement from architect and builder giving us our location when trouble arises

with other companies. With the operation house, the practice is slightly different. We endeavor to fix our location at the earliest possible moment, by supplying sleeves to the builder to be placed in the foundation wall during the construction. These sleeves are nothing more than stove pipes, cut about 15 in. long. A couple of visits of the service foreman, who directs the mason on the job just what depth to place sleeves, generally brings the desired results. As a rule, the builder takes very kindly to this scheme, and we have very little trouble with the plumber or electric company stealing our location.

In answer to the question, "Where does the service end?" I would state that in Philadelphia, we always consider the end of the service inside the foundation wall. There is, however, one exception to this rule, and that applies in large buildings where we install or connect to what is termed a "common riser" or, a better name, "common service." Meters are placed on the various floors and get their supply from this common riser or common service, which contains unmeasured gas.

In answer to the question of wiring a service, I will describe the safety service cleaning device, which will also answer several other questions as well. The idea of the design of this homemade device is to allow a man to wire and pump a service without permitting the escape of much gas. It is constructed for use on ¾-in. services, but can easily be made to suit any size. The plug is removed from the head of the service, the nipple and cock portion of the device being installed with the cock off. The union portion of the cock is then attached to the device. To wire the service, the ⅛-in. plug is removed, wire inserted and cock turned on. The wire can now be pushed through in an endeavor to clear the obstruction. After pulling out the wire, the cock is shut off. Should the service not be clear, the small plug is inserted and both cocks opened.

The service is now filled with alcohol, or hot brine, through the small cock. Either a suction pump or force pump can now be used on the end of the device, and it generally produces the

desired results. This small device I am exhibiting is only a miniature, made for the purpose of demonstrating.

MR. VINCENT: Do you not have to have a curb cock on the service to use that device, so as to shut the curb cock off while you are putting it on the inner end of the service?

MR. DUNCAN: Yes. Of course, it could be done without the cock, by just taking out the plug at the end of the service, a small plug being drilled in the larger plug or tee at head of service. However, if we have cocks, it makes it easier. It affords the opportunity of sending one man instead of two on this kind of work.

In answer to the question pertaining to lost stop-boxes, I might state that we have had very little trouble. Our linewalkers are supposed to pick up all repaving jobs, but as an extra precaution as well as a check on the linewalkers, we supply all paving contractors in the city with postal cards, to be used to notify us of their intention of doing work at a certain address. All that is needed for them to fill in on the card is the address. We find that the scheme works out very well.

Regarding the placing of a service under cellar windows, I might state that this location was mentioned in the paper as being the least objectionable, when the regular location could not be had. By regular location, I mean the one along the division wall between houses, where one trench is dug for two services, one to each house. It is advisable never to place the pipe under the pillar between the windows unless an opening in the wall has been provided. Where no opening has been left, it should be placed under cellar windows or under steps, if latter are in course of construction. The idea is to avoid weakening foundations, and at the same time to keep head of service out of the coal bins. When I say under the cellar windows, I mean placing the service either to one side or the other of the center. This will enable the proper setting of meters without the objectionable feature of having the meter directly in the center under the cellar window, which would, of course, be in the way. You will find very few cases of this

nature, however, about 90 per cent. of the services being on the side foundation walls.

In order to show that our service inspector does a little more work than Mr. Vincent realizes, I would just like to state his duties: He takes care of between four and six gangs, approves or disapproves the location of services in ordinary cases and determines the nature of material needed, as well as regulating the desired time of delivery of material. He acts as timekeeper for his men, inspects completed work, assists gang foremen in making up work cards and reports, and acts as an intermediary between the service foreman and gang foremen. The inspector is also of especial value for preinspection work. He must be a man who has won the respect of his associates, and through perseverance, has shown his superior knowledge of the work.

In reference to automatic gas cut-offs, I might state that we have nothing of that nature in Philadelphia. We have the stop-cock at the curb and the meter cock on the meter connections, but nothing automatic.

In answer to the question of how we handle our electrolysis cases, I might state that in Philadelphia, the trouble caused by electrolysis has been comparatively small, most of the sections affected being around large power plants. In almost every case where trouble has been found on the mains, it has been on old city pipes laid many years ago, before The United Gas Improvement Company took the lease. These mains all had lead joints. Some little trouble has occurred on service pipes, however, and it appears in most cases to be at the joints where they cross the Traction Company's conduits. The Traction Company has, as a general rule, paid for the damage.

I believe I have answered all the questions asked, with the one exception of the construction of our drip pump. It is of the suction type, and is made of brass, with a 2¼-in. cylinder and 12-in. stroke.

THE CHAIRMAN: Thank you, Mr. Duncan. Gentlemen, I know Mr. Duncan has put a lot of work on that paper, and

I think it is up to us to show our appreciation for it. Therefore, I move we thank him by a rising vote

(The convention assembled signified their appreciation of Mr. Duncan's paper by a rising vote.)

THE CHAIRMAN: Mr. W. R. Hulbert, of the Goldschmidt Thermit Company, New York, will now demonstrate the Thermit Welding Process.

THERMIT WELDING.

MR. HULBERT: The Thermit process is not adapted to welding sizes from 8 to 16 in. in diameter. For pipe 6 in. or less, however, it is a very simple and efficient process, and with two men, the welds can be made at the rate of forty or fifty joints per day. The apparatus is light and portable, and no outside heat or power is required. The simplicity of the process is such that I am able to make a weld for you right here in this room.

The Thermit process is based on a chemical reaction between aluminum and iron oxide. This mixture can be ignited at a temperature of about 2,800° F. by means of special ignition powder. The aluminum burns, and in so doing, takes away the oxygen from the iron oxide, forming aluminum oxide, while the iron is set free in the form of superheated steel at a temperature of approximately 5,000° F. The aluminum oxide or slag formed by the reaction is produced at the same high temperature as the steel.

In making a pipe weld, the pipe ends are first squared up very accurately by means of a small portable pipe-facing machine, which can be easily carried and handled. They are then butted together and held securely by means of clamps. The pipe ends are then surrounded by a cast iron mold, and the thermit is ignited in a flat bottom crucible or ladle. At the end of the thermit reaction, the aluminum oxide or slag floats on top of the liquid steel, and when the contents of the ladle are poured into the mold, the slag flows in first. This

slag coats the outside of the pipe and the inside of the mold with a protective coating which prevents the steel, which goes in later, from touching either the pipe or the mold. The whole superheated mass, however, brings the pipe ends to a welding temperature, at which time they are squeezed together by means of the clamps, and a butt weld effected. At the end of the operation, everything can be knocked away from the pipe, and nothing will stick to it whatsoever. The only effect is a slight upset at the joint, produced by squeezing the pipes together, but this upset occurs on the outside of the pipe, and the inside diameter is not reduced. This is due to the outside of the pipe being heated hotter than the inside, so that naturally all the upset occurs on the outside.

The welds can be made as economically in a trench or field as in the shop and can be made anywhere that the pipes are laid. The thermit itself is not combustible at any ordinary temperature, and can be thrown on liquid cast iron without igniting. It is, therefore, entirely safe to transport and store, and will keep indefinitely if stored in a dry place.

(Mr. Hulbert's assistant then completed the demonstration, which was liberally applauded by the members present.)

I have been asked what the cost of the welding is. That depends entirely upon the size of the pipe. Each size of pipe has to have a special mold and a special welding portion of thermit. The mold can be used over and over again, while the welding portion is consumed for each weld. The clamps, pipe facing machine and other apparatus which we have used here on 1¼-in. pipe, can be used on any size pipe up to 3-in.; while we make this apparatus in a larger size for welding pipe between 3 in. and 6 in. in diameter. The crucible can be used ten or twelve times, and then relined at slight cost. The cost of the welding, therefore, is practically narrowed down to the cost of the welding portion plus wear and tear on crucible, and labor. These costs work out about as follows on standard pipe of ½ in. to 4 in. in diameter:

Size of pipe inches	Total cost thermit weld per joint
½	$0.31
1	0.48
1¼	0.65
1½	0.78
2	0.90
2½	1.33
3	1.92
3½	2.69
4	4.03

The first cost of the necessary apparatus for welding pipe up to 3 in. in diameter is about $60.00.

THE CHAIRMAN: Are there any further questions? If not, I wish to thank Mr. Hulbert for his kindness in bringing this process to our attention. The next paper is "The Installation, Repairing and Testing of Meters by a Small Company," by Mr. Charles Otten, Jr., of Haverhill, Mass. Mr. Otten has been prevented from attending this meeting and, therefore, I am going to request the Secretary of this section to read the abstract of his paper.

THE INSTALLATION REPAIRING AND TESTING OF METERS BY A SMALL COMPANY.

INTRODUCTORY.

In dealing with this subject, the writer has considered the needs of a small gas company, that is, a company supplying a community of from 45,000 to 50,000 inhabitants, and which has in operation about 10,000 meters. It has been the endeavor to trace the incidental work connected with the meter department through the various stages from the purchase to the final use in the district.

PURCHASE OF NEW METERS.

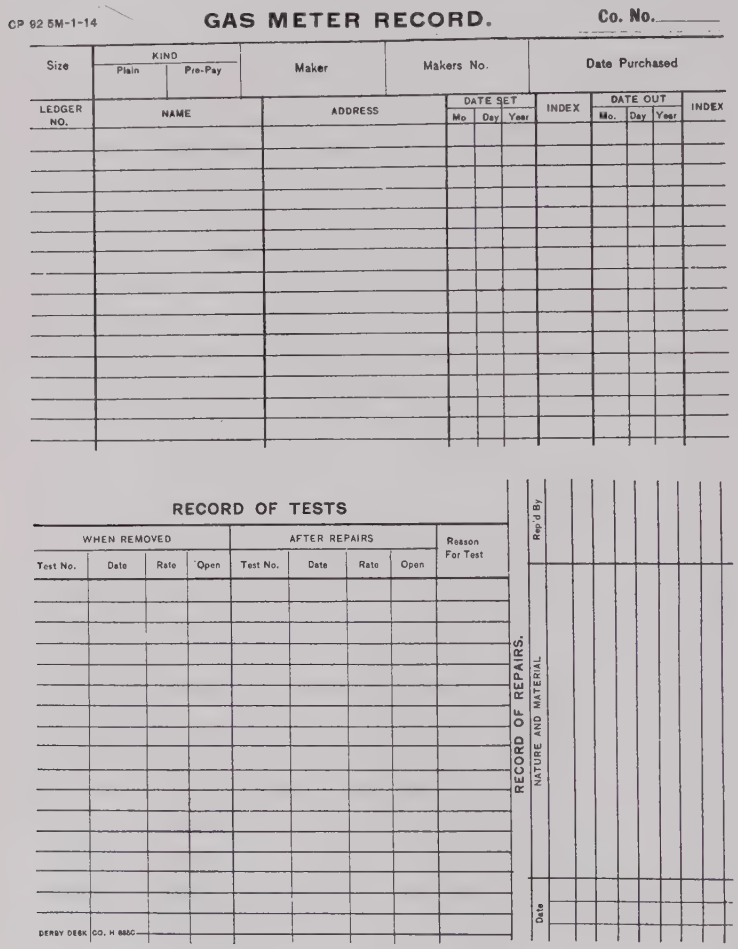
All other things being equal, it would seem best for the gas company to buy all meters of the same make. This reduces the number of repair parts needed in stock, makes it easier to change meters for age, leak or other cause because of the similarity of dimensions, renders it easier for the foreman to break in repair men and simplifies the records greatly. A sufficient stock of meters should always be on hand so that

there could be no delay in supplying customers. This necessary stock depends on the season of the year, on the length of time required for meters to reach the shop from the meter manufacturer, and varies for each individual company. Since many of the meter manufacturers now make deliveries by automobile truck, the companies that are within a reasonable distance and are on lines of fair roads can obtain quick deliveries. Meters shipped by freight are subject to the same delays in transportation as are other goods, and at certain transfer points much time is lost, and allowance for these delays must be made in deciding on the minimum stock to be carried.

Handling New Meters When Received.

As the meters are received at the shop, the makers' numbers should be listed, and if company numbers are to be given, this should be attended to. It does not require much clerical work to keep a record of each meter, and the information so obtained is valuable. A good method is to have a card for each meter, giving the meter number, date received, manufacturer, size and whether regular or prepayment. This should appear across the top as a heading, and below should be lines for a record of the location where the meter is set, the date set, the index and the date removed. On the reverse side could be kept a record of the tests and repairs. These cards should be kept in numerical order by using the company number, or if no company number is given to the meter, the manufacturer's number should be used. Figs. 1 and 2 show two forms of meter record cards. After this clerical detail has been accomplished, and if the meters are to be made "dipping," the oil should then be put in and the meter allowed to stand for a few days, after which it should be tested, it then being ready for service. If meters are not to be made "dipping," they should be tested and then sent out as required. The object of this test is to be sure that the meter was not put out of proof while in transit. In case the meters are to be used in a state where it is necessary to have them

sealed by a state inspector, and the meters have not been sealed before they are received at the gas company's shop, it will be necessary to arrange for this at this time.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GAS METER RECORD.

Co. No._____

Size	KIND: Plain / Pre-Pay	Maker	Makers No.	Date Purchased

LEDGER NO.	NAME	ADDRESS	DATE SET: Mo.	Day	Year	INDEX	DATE OUT: Mo.	Day	Year	INDEX

RECORD OF TESTS

WHEN REMOVED: Test No.	Date	Rate	Open	AFTER REPAIRS: Test No.	Date	Rate	Open	Reason For Test

RECORD OF REPAIRS.

Rep'd By	NATURE AND MATERIAL	Date

DERBY DESK CO. H 885C

Fig. 1.—Meter record card. Page 1185.

A convenient arrangement for storing the smaller meters is by portable meter racks. These can be built of wood or metal and should be about 6 ft. high with shelves spaced to accom-

modate 3 and 5 light meters. The racks may be braced diagonally through the middle from end to end, thus dividing the shelves so that one row of meters can be put in from each side. Figs. 3 and 4 show how these racks can be constructed.

CO 'S NO. | METER RECORD | MFR.'S NO.

DATE REC'D | SIZE | MAKE

SET | REMOVED

DATE	INDEX	FOLIO	NO. STREET	DATE	INDEX
Form 69			DATE CONDEMNED		

REPAIRS			TESTS			
DATE	NATURE	MADE BY	DATE	FAST %	SLOW %	MADE BY
REMARKS						

Fig. 2.—Meter record card. Page 1185.

The inlet or outlet tube should be placed to the front, and if a tag giving the meter number, etc., is wired to the tube, it is not necessary to handle each meter when taking stock or when looking for a particular one. This tag must be used on repaired meters as well as new ones. It should be placed on

new meters when they are being set on the shelves after test, and on old meters when they are being removed from the customer's premises. Thus there is a tag on each meter in the shop. When a fitter takes out a meter which is to be set in the district, the tag should be removed and a notation made on the tag giving the date and the fitter's name. If the meter is not set and is returned to the shop, the tag should be replaced on the meter. The tags removed from the meters

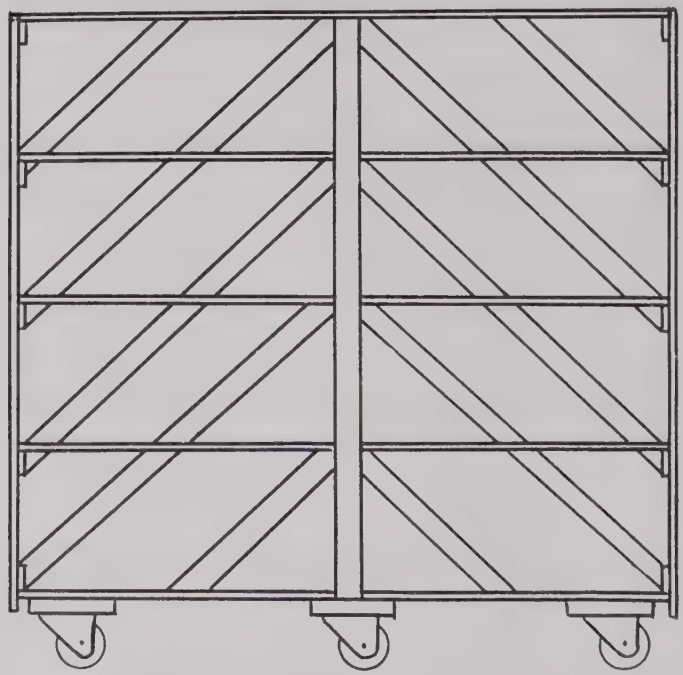

Fig. 3.—Portable meter rack. (Front view.) Page 1187.

that were taken from the shop should be kept until the stock of meters has been balanced on the last day of the month. Fig. 5 shows one form of meter tag.

Record of Meters Set and Removed.

Each day the record of meters taken out should be checked with the completed orders, and any discrepancy existing

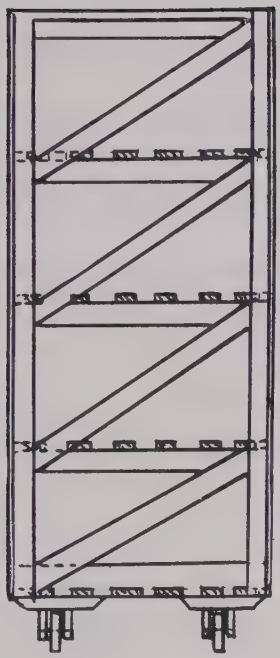

Fig. 4.—Portable meter rack. (End view.) Page 1187.

Co. No.

Size No.

Kind Maker

Index Date

Consumer

Premises

Reason

Location

Removed by

Fitter

REPAIR SHOP

Date Tested

Test (Check)

" (Open)

Non-Register

" " S. F.

Jerky

Date Adjusted

By

Meter Tester

Sent to Repair Shop

Remarks

Fig. 5.—Meter tag. Page 1188.

should be straightened out. The permanent record should then be written up in a meter record book, either having head-

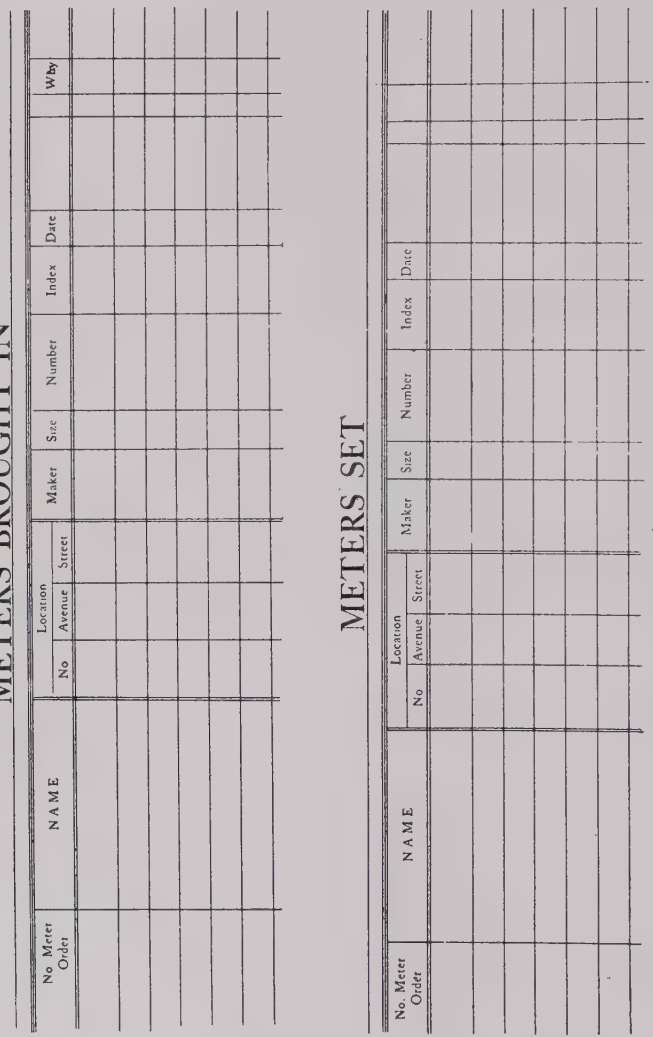

Fig. 6.—Meter record book. Page 1190.

ings as shown in Figs. 6 and 7 or arranged to give other information. The orders should then go to the ledger clerk to

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	Day	Name of Applicants	No	STREET	Make	Makers No. of Meter	Index	Gas Co 's No. of Meter	

REGULAR										Pre-Payments					By Whom Done	Order No	REMARKS	
IN					OUT					IN		OUT						
3-Lt.	5-Lt	10 Lt			3 Lt	5 Lt	10 Lt			3 Lt.	5-Lt	3 Lt	5 Lt					

1191

Fig. 7.—Meter record book. Page 1190.

be entered on the consumers' ledgers. It is considered good practice to have two meter record books and to use them during alternate months. The book not in use should be sent to the ledger clerk and the entries checked with the consumers' ledger in order to be sure that all orders have reached the clerk and the proper entries have been made.

Handling Meters Between Shop and Consumer's Premises.

When a meter is removed, a tag should be attached to it by the fitter before he leaves the customer's premises, and such information as is called for and which he can furnish should be filled in by him. Any unusual condition should be noted on the tag as well as on the meter order. It is a great help to the meter repair man if the tags on meters that were removed for leaks give the location of the leak. It is also well to have the fitter put a chalk mark on the meter at the point where it is leaking. This information is helpful to the meter man for the reason that it is often difficult for him to find the leak, since the fitter may have stopped it with soap or other material. The fact that the place where the meter leaks has been indicated should not keep the repair man from testing the meter for other leaks.

The meters to be set, and also those removed, should be carefully handled and kept in an upright position at all times. and the inlet and outlet should always be stoppered. This last can be accomplished by the use of corks, or tin caps threaded to fit the meter screws.

All meters to be transported on wagons should be protected with felt pads, straw, or, best of all, carpet bags as shown in Fig. 8. These bags are made up of small pieces of heavy carpet, and if an order for them is placed with a furniture house during a slack period, they can be purchased for about 35 cents for the 5 light size and about 55 cents for the 10 light size. The 5 light size may be used for 3 light regulars, 3 light prepays and 5 light regulars, while the 10 light size is used for 5 light prepays and 10 light regulars. They

will last for quite a long time and certainly give full protection to the meters.

When meters are to be transported to consumers' houses on wagons that are also carrying appliances, the wagons should be equipped with shelves for the meters to be set on. These shelves can be arranged across the wagon in back of the driver's seat, or one shelf can be placed on each side of the wagon and extend out over the wheels so as not to take up any of the room in the body of the wagon.

Fig. 8.—Carpet bag for protecting meter. Page 1192.

An illustration of a body is shown in Fig. 9, which is built for attaching to an automobile runabout, and which has proved successful in the transporting of meters. The meters are maintained in an upright position by a strap which is attached by hooks to the side of the automobile body, the latter being provided with an angle iron which extends for the length of body and which has a hole in it every few inches. After the hooks are in place, the belt is drawn tight and fastened by a buckle, so that the meters are firmly held. A

sectional deck may be used if another tier of meters is to be placed over the bottom ones.

If meters are to be carried by men, they may be handled by a leather strap, as shown in Fig. 10, or by a rigid connection which may be used as a handle. The strap just mentioned has an S hook on each end, to which is fastened a 3 light and 5 light meter swivel and ring. If 10 light meters are to be carried out, a 10 light swivel and ring can also be attached to the S hook. If either of these are used, a disc should be

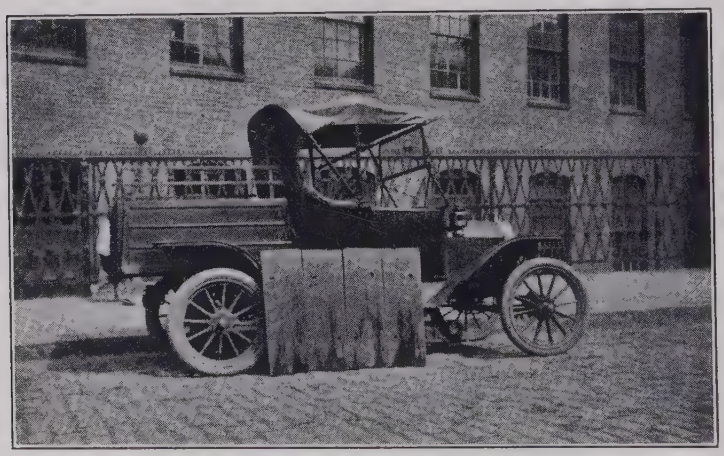


Fig. 9.—Meter automobile. Page 1193.

placed over the inlet and outlet connections of the meter before the meter rings are screwed on or the swivels may be filled with lead.

Installation of Meters.

It is generally conceded that the best location for the meter is near the point where the service enters the cellar. This location is easy to designate, and, in addition, plumbers can lay out the piping so the risers end near this point, and carpenters can arrange the cellar layout for this installation. As it will be necessary to get to the meters each time the index is taken, it becomes advisable to have them accessible. If they are located near the head of the service, accessibility to this point

is increased, which is an advantage, for in case the service needs to be blown out, or the cock needs to be shut off on account of fire or for other reasons, the location is readily seen.

Since it will not always be possible to have the meters located as described above, the question of a proper location should

Fig. 10.—Leather carrying strap for meter. Page 1194.

then be carefully studied so that the best place may be obtained. Since this depends so greatly on the case under consideration, it is impossible to lay down any rules which will be applicable to all.

There are many instances where the company is asked to

set each tenant's meter in their rooms, this being particularly the case in manufacturing centers where people live in furnished flats for light housekeeping. If prepayment meters are set in such cases, the necessity of having a deposit from the customer is avoided, since the paying of a deposit seems to be a hardship for some people. If a prepayment meter is refused, they may be lost as customers, while on the other hand, if they had a prepayment meter, they would do practically all of their cooking by gas. Unless the party renting out the rooms has a master key and will arrange for some one to go with the meter indexer when he collects from the prepayment meters, it may be very difficult to make collections under these conditions. This matter should be gone over carefully and settled to the best advantage according to local conditions.

The meter connections must be made so that the inlet and outlet tubes of meters are not strained. This can best be accomplished by using lead on either the outlet or the inlet, or both, or by the use of either rigid or adjustable meter connections. The use of lead connections has been condemned by many gas men, but they can be installed in such a way that they are not "kinked." This means the use of a short connection and training the fitters, by constant supervision, not to make bends in the connection sharp enough to affect the gas supply. This type of connection has the advantage of being flexible and avoids the possibility of the meter being strained as is so easily the case when using iron pipe and fittings for the same purpose. When using lead connections, a shelf is needed under the meter, there being various types of brackets that are suitable for this purpose. Some companies use an ordinary stiff iron shelf bracket, while others use adjustable brackets, which are made in such a manner that they touch the bottom of the meter for the entire length of bracket, even if the meter is not at right angles with the wall or partition to which the bracket is fastened. When the support for the meter is to be fastened to a stone or brick wall, it is necessary to nail a strip of wood to the wall and then screw the meter bracket to this board. These brackets

can also be installed when using iron pipe or rigid connections. Some types of adjustable bar connections are arranged so that the meter is supported on a board held at each end by a rod fastened to the connection. The bottom of the rod is threaded and a thumb nut holds the board tightly against the bottom of meter. When using the rigid meter connections, the distance from center to center of the inlet and outlet opening is made to agree with the same dimension on the meter by using offset swivels. These swivels are supplied in different lengths.

All connections should be so installed that meters will set level and be a few inches from the wall to allow circulation of air around the meter and thus help to avoid corrosion. The height of the meter should be such that the index can be easily read by a person of average height when standing on the floor in front of the meter.

Large meters should be supported by a stand set on the floor or by strong brackets fastened to the wall. The stand or bracket for large meters with top connections should be of such height that when meter connections are screwed up, the stand or shelf does not come directly up to the meter, wooden wedges being driven in to support the meter. To prevent these wedges being accidentally knocked out, a small nail can be used to hold them in place. This is done so that the meter may be removed without being strained and without the necessity of the piping being pushed up sufficiently to allow the meter to be removed.

After the meter has been set, all the air should be let out of the house pipes and a test made to see if the test hand of the meter moves when only enough gas for a small flame is being passed. If the meter registers on this small flame, the location of the test hand should be noted after all outlets have been shut off and the meter watched to see if the test hand moves during a period of 5 or 10 minutes. If the test hand moves, it indicates that there is a leak in the meter connection or house piping. A simple method for marking

the location of the test hand for this test consists in moistening a small piece of paper and pasting it on the index glass so that one edge of the paper is directly in front of the test hand. While this test is being made, the fitter can put bracket under the meter and gather up his material, thus not losing any time. During this test, he should look at the test hand of the meter occasionally, and if everything is found to be all right, the information as to date, size, kind, number, index, etc., should be filled in on the meter order by the fitter while he is at the meter. If it is found that the house piping or fixtures are defective or leaking after the meter has been set, and the trouble is such that he should not or could not attend to, he should either remove the meter or else lock it so that it could not be turned on, except by a proper representative of the gas company. The reason for not giving service should be explained to the customer or his representative, and this should also be written on the order so that the shop foreman can take further action and also that there will be a record of the transaction. No attempt should be made to turn on the gas unless the fitter can personally enter all of the rooms to be supplied, see that conditions are satisfactory and gas out the piping. This should apply either to the case where a meter is already set, and only needs to be turned on, or where it is necessary to set a meter.

Some companies do not allow any meters to remain in the district after a customer orders the supply discontinued, but remove each meter to the shop. The advantage of this system is that it requires a smaller stock of meters to carry on the business, but on the other hand, it subjects the meter to greater wear and tear. It would seem that with a knowledge of local conditions, the shop foreman could judge whether the premise from which the supply of gas was ordered discontinued would be occupied again shortly or whether it would be likely to remain vacant for some time. In the first case, the meter might be locked and a careful record kept of the locked meters so that any which had been locked a certain

period could be removed. In the second case, the meter might be removed at the start. Unless systematic attention is given to the removal of meters that have been locked for the allowable period, it will be found that the number of locked meters on the district will run up to several hundred in a very short time. The period for which meters are left locked by a company of such size as we are considering, should be about two or three months.

In order that a meter may be easily identified as supplying a certain customer, a sticker can be pasted on the front of the meter giving the customer's name and the date the meter was set.

Removal of Meters.

After, or immediately before, meter removal, the order blank should be filled out by the fitter, and if meter tags are used, one should be filled out and attached to the meter. The meter should be kept in an upright position and placed in a carpet bag or otherwise protected when it is placed on the wagon. The inlet and outlet tubes of the meter should be plugged as soon as it is removed from the connections.

If a meter is removed for special test, it can be more easily distinguished by the repair shop men if a special tag is attached to it by the fitter when it is removed. This tag can be arranged so it may have the result of the test filled in at the shop and sent to the office to be used as a report. Great care should be taken with these meters so that it will be possible to give the customer a full and correct report of the test. It is very annoying and tends to have the customer lose faith in the company's methods, if it is necessary to state that, on account of carelessness, a report could not be made on the correctness of the meter for which a special test had been arranged and an adjustment promised if the meter was found to be wrong.

All meters removed should be brought to the shop before being set again. Each day's removals should be put in a certain place and checked the following morning with the orders

turned in by the fitters, and then the orders should be entered in the meter record book in the same manner as is done when meters are set.

Testing and Repairing.

All removed meters should be immediately sent to the proving room upon their arrival at the shop, and be given the check or proof test within 24 hours after removal. The meters should be allowed to remain in the proving room for several hours before being tested, to acquire the temperature of the room, which should be kept as uniform as possible. This length of time depends on the size of the meter and also on the difference between their temperature when received and that of the air in the proving room.

The meter should be connected to the prover, and the temperature of the water in the prover tank should be the same as that of the air in the proving room, and should be so maintained during the operation of proving. A variation of 5 deg. between the temperature of the air and of the water will result in a variation of about 1 per cent. in the proof of the meter. A separate thermometer should be used for taking the temperature of the water and air as the evaporation of water on the thermometer will cause the mercury to indicate a temperature several degrees below the actual temperature of the air in the room. Enough air from the prover should be passed through the meter to enable the diaphragms to fill and empty from 3 to 5 times.

Before actually starting the check test, it must be seen that the meter and the connections are tight, and that the proving head pointer is on the up run and directly over a division point of the proving head circle. The proper size test cap should then be screwed on the meter outlet tube. The prover should then be carefully set so that the pointer attached to the prover tank will be opposite a unit on the prover scale. The cock on the prover should be opened so that enough air from the prover will pass through the meter and cause the proving head pointer to make two complete revolutions on a 2 cu. ft.

proving head, and one revolution of the larger sizes of proving heads. The scale attached to the prover should then be read and reference made to a "Percentage of Error Table," in order to obtain the error of meter registration, corresponding to the reading obtained from the prover scale. This error is originally obtained by finding the difference between the prover reading and the meter reading, and then determining what percentage of the prover reading this difference is. A meter which proves within the limits of plus 2 per cent. (fast) and minus 2 per cent. (slow), may be considered as correct. Two per cent. is the limit of error usually permitted by the officials, but some companies while they have the meters in the shop, remove the tops and adjust those meters which prove beyond the limits of plus 1 per cent. (fast) and minus 1½ per cent. (slow). When the error is greater than these limits, but less than (say) 6 per cent. fast or slow, the meter top should be removed after the meter has passed the "jerky" or "burner" test and the "slow motion" test as described below, and the meter adjusted by moving the tangent post in or out on the tangent arm until the meter proves within ½ per cent. of correct proof. When proving a meter which has the top removed, only one complete revolution of the pointer on a 2 cu. ft. proving head need be made, care being taken to stop the tangent arm in the position it started from after the pointer has made approximately one revolution.

After receiving the check test, the meter should be subjected to a jerky test, which is made by connecting the meter to a gas supply and to a burner bar, upon which are mounted a number of open flame burners. The object of this test is to determine whether the meter will pass gas without causing a marked variation in the outlet pressure. One or more burners should be turned on and the meter thoroughly purged, after which the burner, or burners, should be lighted and the flame, or flames, observed for fluctuations. Any decided fluctuation warrants the meter being opened and thoroughly overhauled. A single flame will usually suffice to show any catch or bind

in the meter, but, in case of doubt, a number of burners, the combined consumption of which does not exceed the capacity of the meter under test, should be lighted and the flames watched for any fluctuation during at least one revolution of the tangent arm.

If the meter passes the jerky test, all of the flames except one should be extinguished. This one flame should be reduced to consume about ½ cu. ft. per hour. This test is made to determine the ability of the meter to register the passage of small volumes of gas. Sufficient time should be allowed to permit a noticeable movement of the proving head pointer, but no attempt is ordinarily made to check up the accuracy of registration by means of this test. However, it is obvious that the registration of the meter may be readily checked against the consumption of the slow motion burner and thus internal meter leaks discovered. In addition to making the check, the jerky and the slow motion tests, the meters should receive a careful external examination, and any minor defects at meter screws, leaks at soldered seams, dents in the meter body, broken glasses, or damaged index box lids, should be repaired.

If a prepayment meter is under test, the buying mechanism should be examined and operated with a coin, and then tested at least 3 times in succession as follows: Before removing the meter from the slow motion test connections, the prepayment valve should be closed by hand, and it should be seen that the light at the slow motion burner goes out. If it is necessary to adjust the meter, after it has passed both the jerky and the slow motion tests, the prepayment valve should again be opened, the top removed, and the meter adjusted, after which the top should be replaced and the prepayment valve closed by hand same as before. Some companies send the prepayment meters out with the valve opened enough so that the fitter can gas out the house pipes, even if the customer does not have a coin. The objection to this is that the fitter cannot have the customer actually operate the buying mechanism in his presence.

No meter which has been tested after removal from service, should be placed in the O. K. stock before it has been carefully painted with a fairly quick drying meter paint, but under no conditions should an enamel paint be used for this purpose, since it becomes too hard and brittle.

Where it is the practice to introduce oil into the diaphragm chambers, in order to have the diaphragm dip into it, and where the meters received from service are of both the dipping and non-dipping classes, the limits of error of registration within which it is permitted to make adjustments, may be increased for each class of meter with perfect safety. This limit in the case of dipping meters, may be raised to 8 per cent. either way, and in the case of non-dipping meters, to 10 per cent. before putting in the oil. In this last class of meter, if the first check test is 10 per cent. or under, the oil is introduced and the meter set aside. If it is a 10 light meter or smaller, this period is 10 days, and for a 20 light or larger, it is set aside for 20 days. The meter is then given the second check test, and if found to be beyond the accepted O. K. limits of error, but not over 8 per cent., the top is removed and the meter adjusted.

All meters removed for age, however, should have front and backs removed regardless of the test rating when the meter came to the shop. All age meters and all meters on which the proof falls beyond the limits within which a meter may be adjusted, should have the fronts and backs removed, as well as the tops, and the diaphragms should be carefully tested and examined for leaks and other defects. If the diaphragms under test are sound, they should have diaphragm oil worked into them. A convenient arrangement for doing this work consists of a galvanized iron stand with the top sunk a little and which drains to one point. The top of this stand or bench should be large enough to hold about 6 5-light meters when laid down. Some oil is poured into one diaphragm chamber of each meter and worked into the diaphragm, and the meter is then turned over and the same operation repeated on the

other side. The surplus oil drains to a pail and can be used again providing the meters were cleaned before being brought to the oiling table.

In some cases it has been found that better results are obtained if the oil is put into the diaphragm chambers through holes which are punched in a manner similar to those punched for dipping meters. In this way the oil gets to the diaphragm before it is exposed to the atmosphere, and it is claimed that the oil is better absorbed by the leather. In some places the oil is heated before being put into the meter. With the above method of oiling, the meter is then allowed to stand for some time before being opened.

All meters in which the diaphragms have to be replaced should have the old diaphragms removed, together with the index and valves, and should then be boiled out in a tank of water and caustic soda or some other similar preparation.

Care must be taken to replace the fittings on the same meter from which they were removed, and in order to identify the valves, etc., various systems have been worked out. One company places all the fittings for a particular meter in a little numbered bag. In order to identify the bag with the case, they have a nut numbered correspondingly to the number on the bag. This nut is screwed on to the inlet connection of the meter. Another company uses a tray of square compartments, each one of which is numbered, and the number of the compartment into which the fittings from the meter is placed is then scratched into the meter case. This practice is not recommended, as the coating of tin is injured by the scratch marks. After the meter has been cleaned in the caustic soda, it should be equipped again and adjusted, painted, etc.

Shop Organization.

In a company such as is referred to in this paper, the shop organization should consist of one experienced meter repairer, who should be in charge, and he should have at least 2 men as helpers, unless it is necessary that he or one of his men look after clerical work, in which case more help would be

required. In a company of this size, there would be work enough for a distribution shop clerk, who could look after clerical work in the meter shop, together with his other work. One of the men should be able to do ordinary meter repair work, such as putting in diaphragms, grinding valves, repacking stuffing boxes, putting in indexes etc., while the other man may be lower priced and do the topping up of meters, replacing fronts and backs, painting, boiling off meters to be repaired, etc. The shop foreman should do adjusting and final testing and as much regular repair work as possible. Whether three men will be able to take care of all the work in the meter repair shop depends on the length of time that meters are left in the district before being removed for "age," for if meters are exchanged after 5 years service, there will be more meters coming to the shop for repairs than would be the case if meters were exchanged after they had given 7 years service. From a meter shop view point, the best arrangement to take care of the changing of meters for age is to have an equal number changed each month. This is sometimes difficult for the fitting force, but should be followed out as closely as possible, as it will not remove so many meters from stock and the meter shop force will then have a fairly uniform amount of work to do each month.

In conclusion, the writer would add that the employees in every department of the gas company should be informed about the great accuracy with which consumers' meters register the gas used. They will then be able to intelligently discuss this matter with the public when accuracy of meters is questioned.

(Abstract of paper read by Section Secretary.)

Mr. W. A. Castor (Philadelphia): The best interests of a small gas company having 10,000 meters, will not, in many cases, warrant the outlay necessitated in maintaining a meter repair shop capable of making all kinds of repairs to the consumers' meters removed from service. Many gas companies

having from 20,000 to 30,000 meters, for various reasons ship their meters to the meter repair shops of large companies, or to the meter manufacturers for the purpose of having the more expensive and difficult repairs made.

The suggestion that a gas company purchase meters of one make, thereby simplifying the setting and repairing of the meters by the company owning them, is a good one, but should not be taken too seriously, for the reason that this condition is seldom, if ever, met in actual practice. Many gas companies have started out with this intention but, for one reason or another, eventually have purchased meters from more than one manufacturer. Probably no gas company of moderate size, or any small gas company which has become financially sound after a period of operation, or which has had one or more changes in management is using but one make of meter. No gas company would care to pledge itself to the purchase of meters from one manufacturer, if under ordinary conditions it could profit by buying elsewhere, thus taking advantage of lower prices and improvements.

Small gas companies, and others as well, may readily facilitate the shipping of new meters from the shops of the manufacturers, and thus assure the maintenance of their stock of meters available for consumers, by sufficiently anticipating their requirements to permit the manufacturers to work under normal conditions, and to deliver the meters as required. Unless the policy of a company is suddenly changed, it is feasible and practical to prepare a schedule of the number and kind of new meters which will be required each month of the ensuing year, based on the meter stock and on the purchase of new meters during previous years. The company with which I am connected has made this their practice, placing orders with the meter makers well in advance of actual need, giving shipping instructions covering the delivery of a fairly uniform number of meters throughout the year.

It would seem advisable to give each meter a gas company's number, for the reason that such numbers will be of smaller

denomination then those of the manufacturer; will start at one and run in consecutive order, thus making it easier to write up card or book records, and to refer to them as occasion requires; will enable the loss, or misplacement of a record card to be detected quickly, and in other ways assist in the keeping of meter records. The use of company number meter badges enables the persons handling meters and meter records to form some idea of the age of the individual meters, which information will be found useful in more ways than one. Meter manufacturers will attach the gas company's number badges to the meters gratis, provided these badges are supplied at the time of placing the order for new meters. This will save some expense and handling, and will enable the records to be written upon receipt of the meters from the manufacturer so as to show both the meter manufacturer's and the gas company's number. Company number badges should be attached to the front gallery plate, for the reason that this portion of the meter is seldom removed from the meter during its course of repairs, thus assuring the number badge remaining with the meter upon which it was originally mounted.

Many gas companies keep meter records according to both manufacturer's and company's numbers. This complicates the work in the office without offering any marked advantage over the practice of keeping meter records according to company's numbers only. When the records are kept according to both numbers, it is necessary to replace the meter fronts, to which the maker's number badges are soldered, on the meters from which they were removed while undergoing repairs, necessitating additional and unnecessary work in the repair shop. Several meter manufacturers are now placing their badges showing the maker's number and the capacity of the meter, under a five-tenths loss in pressure, upon the front gallery plate, so that it does not become necessary to replace the same front on the meter from which it was removed during repairs. When a meter is purchased, the entry of both maker's and company's number upon all meter records originated at

that time, such as meter record book, location card and repairs card is advisable, but after that, there need be no notice taken of the maker's numbers in the usual handling and repairing of the meter.

The use of the word "plain," or "ordinary," is suggested to designate meters other than those of the prepayment type, instead of the word "regular," inasmuch as either of these words seem to describe the type of meter better than does the word "regular."

In order to keep a compact and complete record of the purchase and final disposition of meters owned, and to have a basis for starting new records of meters in the event of the destruction by fire, or otherwise, of the various office records, it is advisable to enter in a book,(Meter Record Book) date received, company's number, size, kind, maker and maker's number of all meters owned and of all additional meters received from time to time. These books should be stored in fire-proof safes, or vaults, and should be returned promptly after any necessary entries have been made in them. When a meter is condemned, converted, lost or stolen, or finally disposed of in any way, the proper entry should be made in the Meter Record Book.

Probably the easiest, best, and in the long run, the most economical method of keeping records of individual meters, in order to show the locations at which they have been set, the results of proof tests upon their removal from service and the various repairs the meters have received, is to have separate cards for each meter, and to make the necessary entries on these cards in order to meet the requirements of the various state, or municipal, public service commissions, and of the individual gas companies. A separate 3-in. by 5-in. card for entry of the locations at which the meter was set, and a separate card of similar dimensions, for entry of the proof tests and repairs of the meter should be kept, as in this way the record cards may be utilized to the best advantage, and the particular information desired at any time, may be obtained more readily

than it could be if all data were entered on one card. The following forms are suggested for the keeping of the separate records as referred to above.

SIZE	KIND	Co. No.	MAKER	MAKER'S NO.
		METER LOCATIONS		

SET				REMOVED	
DATE	INDEX	STREET	HOUSE NO.	DATE	INDEX

The back of this card need not be printed with headings shown on the front, but should be printed for entries under the headings of "Set" and "Remove."

SIZE	KIND	Co.'s No.	MAKER	MAKER'S NO.
		METER TESTS AND REPAIRS		

DATE PURCHASED		DATE CONDEMNED		
PROOF UPON REMOVAL		REPAIRS		
DATE	ERROR	NATURE	MADE BY	DATE

The printing and ruling on the back of the repair card should be similar to that on the front of the card under the two headings "Proof upon Removal," and "Repairs."

In order to facilitate filing of these cards, after filling up

the spaces on the face, it probably would be advisable to place the company's numbers on the back of the cards at that time.

The information obtainable when a new meter is received, should be entered on both the Location and Repair cards immediately upon receipt of the meter.

There does not appear to be any necessity for entering upon any permanent record, the result of open column tests upon the final adjusting of the proof of the meters at the company's repair shop, inasmuch as it is safe to assume that the men, who do this class of proving and adjusting, will always bring the open column proof within the smallest limits of variation from the final check proof prescribed by the gas company. Likewise, it does not appear to be necessary to keep a record of the final proofs of meters after adjusting, or after making repairs, for the reason that in such cases it is reasonably safe to assume that the men who prove the meters do so in accordance with instructions calling for correct proof, or as near correct proof as it is possible to bring the meter; probably never more than ½ of 1 per cent. in error either way. The records of test of meters required by the several public service commissions are not the results of the open column tests, but are the results of the check tests of the meters, obtained by means of a restricted outlet which permits of the meter operating at a medium rate during the test. When meters are inspected and sealed by inspectors working under the direction of commissions, the final proof of the meter must be within certain prescribed limits of error, but there does not appear to be any good reason for keeping a record of the proof of the meters at the time they are sealed and placed in stock.

A word here about meters in stock ready for shipment to the consumer: Care should be exercised to send them out in about the order in which they are placed in stock; repaired meters and those which have been in service should be sent out in preference to sending out new meters. If, by any chance, a meter has stood in O. K. stock for a period of 1 year, it should be retested before being set. If the meters in stock

are of the non-dipping class, probably six months would be a better time limit.

The keeping of all unnecessary records, or of records that have outgrown their usefulness, should be avoided and particularly does this apply to the smaller gas companies. In line with this statement, the keeping of a separate card record of meter proofs and repairs may not be necessary under certain conditions. If it were thought to be advisable to keep a record of tests, or if it were compulsory to do so, the meter test cards, which should be attached to every meter entering the company's meter shop, and upon which the results of all tests should be entered, could be filed according to company's meter numbers for a term of years or permanently, or the results of the tests could be entered in special books in chronological order. The combination of the test card file and the record of tests book would enable all data concerning any meter tests to be obtained at any time, and the results of meter tests to be summarized year by year. Several gas companies do not keep any book or card record of the meters repaired, but solder small brass tags to the gallery of the meters repaired. These tags are stamped to show the month, year and kind of repair made to the meter. This practice may entail a slightly greater expense at the outset than does the keeping of repairs records, but, in the long run, it offers many advantages in the subsequent handling and repairing of the meters to offset the increased first cost.

Mr. Otten has called attention to the necessity for setting aside meters into whose diaphragm compartments, oil has been introduced, for a few days before proof testing them. Complete instructions for introducing the oil, and for handling and testing the meters after the oil has been introduced, are given in Pamphlet No. 5, printed by The United Gas Improvement Company, of Philadelphia.

The suggestion that portable meter racks could be used for the storage of active sizes of meters in the meter shops, should be given careful consideration before attempting to follow

this plan An excessive number of such trucks, or racks, would be required in order to handle the meters. Meter trucks cost considerable money, and require frequent overhaulings, extra wide aisles would be required, the storage floor spaces could not be used to the best advantage and the wear and tear on the flooring would be excessive. Movable trucks, or racks, serve their purpose to best advantage in conveying meters received from the manufacturer, or from the street, into the meter shop; from the meter shop to the O. K. meter storage space, and for the accumulating of a number of O. K. meters from stock for delivery to the consumers' premises by the meter wagons, or for shipment to an outside repair shop. The meter rack shown in Fig. 3 p. 1188 should be constructed so as to leave both sides of the shelves open for the loading and unloading of meters from either side of the rack. This could be accomplished by leaving out the diagonal bracing and, in turn, making the end upright pieces of slightly heavier material, securely bracing them at each shelf by means of knee, or angle irons. The shelves should be of solid flooring instead of being made up of strips, the wheels under the middle of the rack should be slightly larger than the wheels at the four corners, in order to facilitate the turning and handling of the racks. For convenience in loading the racks, and to prevent them from being top heavy when loaded, the flooring of the top or fifth shelf should be left off.

When the fitter removes a meter, he should tie a tag to the outlet screw for the purpose of identification. This tag should be so printed as to enable the results of meter tests, and, if desirable, the kind of repairs made to be entered on it. The following tags are offered as suggestions: the Meter Test Tag to be used by the fitter who removes the meter and by the men in the ordinary meter rooms, and the other form, or Shop Repair Tag, by the men in the meter repair shop.

When the meters in either case have been painted and are ready for O. K. stock, the printed tags should be removed and sent to the office for transfer of desirable data and for filing.

METER TEST TAG

CO.'S NO. | SIZE

Rem. by | District

For

From

Date Rem. | Index

Class No.

Sent to M. H.

(*Reverse side.*)

WORK	What Result	Done by
CHECK TEST		
BURNER TEST		
DRAINED		
9" PRES. BOTTOM		
CONDITION OF SCREWS		
BUYING MECHANISM TEST		
OIL PUT IN		
SLOW MOTION TEST		
P. P. VALVE CLOSED		
9" PRES. BOTTOM		
STUFFING BOX LEAK		
CONDITION OF SCREWS		
BUYING MECHANISM TEST		
OIL PUT IN		
SLOW MOTION TEST		
ADJUSTED TO		
9" PRES. BOT. & TOP		
P. P VALVE CLOSED		
BURNER TEST		

A convenient method of keeping a meter stock record is to write a plain, 3-in. by 5-in. card for each meter received from any source, showing the size, kind, index and date. These stock record cards should remain in file as long as the meters remain in stock. When the meters are taken out of stock to be set, the corresponding stock cards should be lifted from file and held against the return of the completed meter order

PUT IN SHOP

COMPLETED

INDEX

	REQUIRED	DONE BY	REJECTED
DIA. OILED			
TINNED			
CH'L'S GASSED			
NEW DIA.			
DIA. GASSED			
CASED IN			
GROUND			
PACKED			
FITTED UP			
GASSED			
PROVED			
TOPPED			
GASSED			

ORDER NO. SIZE

CO. NO.

cards upon which the work was done, or of the meter itself. When meters are shipped to an outside repair shop, or returned to the meter makers, the stock cards should be lifted from file and held as a check against the return of the shipping lists covering the meters shipped. In this way, the stock of meters on hand at any time may be determined quickly and accurately.

The form shown in Figs. 6 and 7, pages 1190 and 1191 for meter location, or set and remove books could be simplified somewhat. For this purpose it is only necessary to show date, company number, size and address of each meter set or removed. The sets and removes should not be entered on the same page, but on separate opposite pages. If ruled columns are provided for the several sizes of meters, the totals by sizes may be obtained readily.

The importance of capping meter screws immediately upon disconnecting the meter should be patent to all. It is a well established fact that air, if permitted to enter the meters, will change the condition of the meter valves and diaphragms, and affect the proof obtained at the meter shop, so that it will not show the actual error of meter registration at the time the meter was removed from the consumer's premises. Air in long continued contact with meter diaphragms that have been in service, will cause a destructive action on the leather to take place, consequently, it is most important that air be prevented from freely entering such meters at time of removal and while in stock.

Carpet bags undoubtedly would prove ample protection to the paint on meters carried in the meter wagons, but the first cost of such bags, the time consumed in placing the meters in the bags and the unsightly appearance would be objectionable features in connection with their use. Meters may be sufficiently protected in the meter wagons by using small canvas covered felt pads between them, strapping the meters by means of individual straps, in position on padded shelves, fitted up with padded strips at the back. After setting a meter, any unpainted tinned metal surfaces should be touched up with the proper meter paint before the fitter leaves the premises.

When meters are carried by hand, special means for so doing should be provided in order that the meter screws will not be subjected to unnecessary strains. Canvas slings, shawl straps, special straps to go around the body of the meter, or a

rigid connection between the two meter screws to serve as a handle for carrying the meter, should be used.

The portion of Mr. Otten's paper referring to the installation and removal of meters contains many valuable instructions and suggestions. In order to cover the various phases of meter work, however, such as meter reading, general requirements, turning on and shutting off gas, setting, changing and removing meters, and prepayment meter complaint work, would necessitate a more lengthy treatise of the subject. The conditions under which it is necessary to do meter work vary in different communities, and in accordance with the policies decided upon by the separate gas companies. It would seem advisable for all gas companies to have printed, or typewritten, instructions to cover this class of work, and to have proper employees familiarize themselves with such detailed instructions, covering not only meter work, but all other work of the fitting department. The employees should be required to read these instructions from time to time, and to sign their names to a statement that they have done so. No set of such instructions to the fitters, will, however, insure their work being done in accordance with the instructions. The work of the fitters in a small, or in any size, company, will need to be inspected occasionally or at regular periods, by some one who is familiar with all requirements, and who is capable of making proper inspection and criticism. Eternal vigilance is the price of good work in connection with meter work at the consumer's premises.

In reference to the work of installing meters, it might be well to state that the use of all-lead meter connections, and of iron inlet and lead outlet connections has been discontinued by one of the largest gas companies in this country. For a number of years, all of the meter connections installed by this company have been all iron, with suitable swing joints to permit the meters to be set without subjecting them to strains, and to provide for the variable widths of meters when making subsequent meter changes. The use of all-iron connections

has resulted in fewer strained screws and solder seam leaks, and has provided a more lasting and safer method of connecting meters than was afforded by any other method. In small towns, where the danger from damage, fires and thefts is not as great as it is in larger communities, it may be advisable, however, to use lead meter connections, as they afford the easiest and quickest method of setting and changing meters; especially is this so when competent and experienced fitters are not always obtainable.

When a number of risers terminate at a common location, it is advisable to tag each riser in a permanent manner, in order to show the portion of the building to be supplied, rather than to attempt to tag each meter when it is installed.

The necessity for adopting a proper schedule of the sizes of meters to be set under the various conditions, cannot be overlooked, as otherwise, the gas company will be subjected to unwarranted expense in setting meters that are either too large or too small, in installing connections of improper size, and in the resultant complaint work. The manufacturers now are making meters of enlarged capacities, and, in some instances, are badging them, to show the hourly capacities under a 5/10 in. loss in pressure. Further, there does not appear to be any necessity for a gas company to purchase large meters of the old type, or to purchase meters with flange connections, for the reason that meters of enlarged capacities, but of comparatively small external dimensions, and fitted with screw connections, can be purchased. When it becomes necessary to supply gas in greater quantities than the rated capacity of the largest size of this type of meter obtainable, one or more of such meters may be connected in parallel at less cost than would be the case if a single meter was installed with flange connections.

The present practice of proving meters in Philadelphia calls for one revolution of the proving head pointers of all sizes of 2 cu. ft. proving head pointers were required when proving meters. Previous to June of this year, two revolutions of all

meters with tops on. A careful investigation of the subject showed that in the proving of 415 3-light and 5-light meters, first obtaining the proofs upon the completion of one revolution of the proving head pointers, and then continuing the test without disconnecting for another revolution of the pointers, using saturated gas as the medium for obtaining the proof tests, the average fast errors of the two sets of tests differed only 0.27 per cent. and the average slow errors differed only 0.23 per cent. The sum total of the errors of the meters were the same on both the 2 cu. ft. runs and on the 4 cu. ft. runs. The result obtained, covered the work of five men working in five different district meter rooms. By changing from the practice of making two revolutions, to that of making one revolution of the proving head pointers, a saving of about 35 per cent. of the labor on about 85 per cent. of the meters proof tested, and of about 40 per cent. of the saturated gas used for this purpose was effected.

Meters removed for age need not be opened for examination of the diaphragms each time they are removed for this reason. The age in service limit as prescribed by the various state commissions ranges from three to six years, which, in most cases, is entirely too short a period to be considered as the life of the diaphragm. Based on the average life of diaphragms, in each situation, as determined by data on the subject obtained by a careful examination of the repair records, considerably longer periods of time than prescribed by the commissions may be decided upon as the age limit of the diaphragms, which would necessitate the opening of the meter at the local repair shop, or the shipping of the meter to an outside repair shop. The time required to look up the age of the diaphragm in each meter will be spent profitably in thus avoiding unnecessary and expensive repairs to meters. The badging of the meters, to show the kind and date of last repairs, as previously touched on, would greatly facilitate the work of determining which meters should be opened and which ones should not. When it is known that non-dipping meters

are to be opened and the diaphragms exposed, the best and cheapest plan is to remove the fronts and backs at once, no matter if the diaphragms do dry out upon exposure to the atmosphere, producing what are known as bleached diaphragms. In these cases, the bleached and slightly hardened sheepskin will take the neutral oil readily, and become soft and pliable under the small amount of hand kneading which all diaphragms receive in the meters undergoing clean and oil repairs.

There is no need for heating the light macihne oil used for the re-oiling of the diaphragms in meters undergoing repairs, or when changing the meter from the non-dipping to the dipping class, but the heating of the mixed diaphragm oils, consisting of heavier oils, which tend to congeal at moderately low temperatures, is a proper and necessary measure under certain working conditions.

The only fittings which it is essential to keep associated with the meter undergoing repairs are the meter slide valves. This is accomplished in one meter repair shop by placing the valves in a small, draw string, canvas bag at the time they are removed from the meter at the opening bench. The shop repair card then is strung on the draw string and both card and bag are hung on the outlet screw of the meter, and remain there until the meter is fitted up and painted. It is the practice, in some shops, to replace the back plates, the indexes, the slot parts, the cases, the tops, and, in some instances, the cash boxes, on the same meters from which they were removed. This is accomplished by scratching the same number on the parts removed and on the meter from which they were removed. If it is desirable to replace the same maker's number on the meter from which it was removed, and the meter and meter parts are not numbered as described in the above, the shop tag should show the maker's number, and the corresponding meter front should be selected and replaced.

There is no need for the same index to be replaced in the meter from which it was removed during the course of repairs, although some companies may prefer to keep the indexes and

horizontal axles associated with the meters from which they were removed. Care should be exercised, however, when replacing indexes in meters, to see that the index proving head is the correct size for the meter in which the index is to be mounted. The capacity of the proving head, as marked on the index dial, should be checked very carefully by the man who proves the meter to see that it is marked in accordance with the cubic feet actually passed per revolution of the proving head pointer, as determined by his prover scale reading. No other checking of the index or index gearing is necessary under ordinary conditions of meter repairing and testing.

Under ordinary conditions of proving and adjusting meters upon their removal from service, a check proof is all that is required by any state or municipal regulations. When it is evident that the flag arm joints have been strained, or the tangent has been shifted, or any condition brought about which would tend to change the original correct setting of the valves in relation to the stroke of the diaphragms, the meter then should be proved on both the check and the open test after necessary repairs have been completed. Care should be exercised when making these tests to be certain that the ratio of speed of operation of the meters during the two tests is at least two to one, inasmuch as the value of these tests lies in the fact that the meters should be tested under greatly different speeds of operation, in order to be assured that the valves are properly set to enable the meter to measure and record the volumes of gas passed under all ordinary conditions of operation, with the same degree of accuracy. It should be easy to see the fallacy of attempting to prove a 100-light meter at the check rate of 575 or 600 cu. ft. per hour, and then at double this rate of flow on the open column test, by means of a 5 cu. ft. prover fitted out with the usual connections, which permit of a flow of but 600 cu. ft. or less through the open connections when the prover contents are permitted to escape directly into the atmosphere. The check test cap capacities for meters 100-light and larger, as per the schedules in general use at this

time, are entirely too large, and should be, and we hope will be reduced in the near future, so as to enable the check and open tests to be made properly by means of smaller provers than are required in accordance with present practice.

Before deciding upon the policy of repairing all meters locally, it would be advisable to give the subject careful study, and to make a thorough investigation of the results attained by other gas companies of similar size which have established meter repair shops. Some propositions which on the surface appear to be very simple and to offer numerous advantages, contain many hidden obstacles and objections, otherwise, for instance, why do not large gas companies make the castings, meters, piping, fittings, fixtures, etc., for which they have such a great demand? The man or firm specializing along one line, invariably produces better and cheaper results than can be produced when a number of lines of work are undertaken, and in consequence, receive the divided attention of the managers, superintendents, or other officers in charge.

Under the most favorable conditions, extensive meter repairs may be made at a saving in the meter shops of a small gas company, especially when the meters owned comprise but a few makes, are not too ancient; where the freight and handling charges necessitated in shipping meters to the nearest repair shop are excessive, and when the prices charged for repairs are high, or the tendency of the outside repair shop is to condemn meters rather than to make expensive extra repairs to them. In a meter repair shop of a small gas company, where the work must necessarily be performed by a few employees, and the expense entailed in the keeping of a cost record of all labor, material and operating expenses chargeable against each kind and size of meters according to class or repair made would be prohibitive, it is absolutely essential to have an experienced and capable working foreman who will keep in mind continually the necessity for producing best results at the minimum expense. A man of this sort is the rare exception, and unless he is of the right fiber, he gradually

will fall into careless, easy-going methods as the result of close association with fellow workmen, and his knowledge that no check is maintained, which will enable the management to know whether or not the cost of meter repairs is excessive. These conditions probably exist in many shops, and no one is called to account, for the simple reason that there are no data available to show costs. Further, men who are experienced in meter repair work, who are conscientious and have executive ability to enable them to deal with fellow bench hands and helpers demand considerably more money than most managers seem willing to pay. The result is, that meter repair men who leave the large repair shops with the view of bettering themselves, are, in most cases, disappointed with the conditions confronting them in the smaller situations. These men move on to the next town in the hope of finding bettter paying positions, or they return to the larger repair shops where they were enabled to earn more money without the added worry caused by the responsibilities thrown upon them in the smaller shops. Meter repair men formerly had the reputation of being rovers, and I am led to believe that this view is still held by some gas company officials to-day. I do not believe the fault is as much that of the repair men as it is of the policies of the gas companies that hire them. The matter of educating employees to the position of working foreman of the meter repair shop of a small company, is one which should be given careful consideration. It is necessary for such an employee to have exceptional ability along several lines, to have the opportunity to learn the work under the guidance of an experienced meter man, or in the shops of a large gas company or in the repair shops of the meter manufacturers. After he has gained the necessary skill and knowledge in this way, he must be exceedingly loyal, or have strong home ties to remain with the small company under the usual conditions of much lower pay for his services than he knows he can receive elsewhere. The point is, that in large repair shops, the work is of such volume that the best paid and most skilful foremen and workmen may be employed profitably to both employee and employer, the high-

est efficiency may be attained, the very best conditions and newest machinery and tools provided, and accurate costs may be obtained at comparatively little expense in comparison with the volume of work turned out by such a shop to that turned out by a small one.

In considering the question of establishing a meter repair shop for the making of all kinds of repairs to meters owned by a small company, the following are some of the points to be given attention: Shipping costs, hauling costs, packing and unpacking meters, effect on minimum meter stock, number of meters condemned at time of making repairs, space required, rent and operating charges, cost of equipping and maintaining shop, interest and depreciation, taxes, insurance, store-room stock required, losses due to theft or carelessness, retesting and readjusting meters received from the meter repair shop, proportion of salary of manager or other officers in charge, volume of work available at all times to warrant the employment of a well paid working foreman and a fairly uniform force of lower priced workmen, and many others.

To operate a meter repair shop, it is necessary to know what new repair parts are required to maintain a properly stocked storeroom, in order that repairs to the meters will not be delayed awaiting the arrival of needed repair parts. All repair parts purchased will be sold by the meter manufacturers at a profit, and freight and express charges will have to be paid, so that any waste, or theft of parts or material, will effect a material off-set to any possible saving on the meter repair work done locally. The making of meter diaphragms requires the service of too skilful workmen, and of too large a stock of raw material to warrant the manufacture of diaphragms by any but a large shop.

In the event of meters being repaired in the company's repair shop, the routine of handling and of repairing the meters should be determined in each case in accordance with the policy adopted by the company operating the repair shop, depending upon the extent to which they desire to enter into the work of

repairing meters. The organization of the meter repair shop would depend largely on local conditions, volume of work, extent to which records are to be kept and requirements of state or municipal commissions. A well paid working foreman would be required under any circumstances; he should be assisted by one or more employees, preferably men of families, or those having ties, which would tend to keep them from going to other cities or towns, who have been taught to make miscellaneous repairs, such as putting on new bottoms, sweating in screws, putting in diaphragms, grinding valves, repacking stuffing boxes, fitting up meters and proving and adjusting meters. Such work as opening meters, boiling out, testing meters for tightness during course of repairs, replacing fronts, backs and tops, painting, storekeeping, janitor work, etc., could be performed by lower priced employees.

The shop layout for the repairing of meters should be such that the meters would enter the shop at one location and proceed in logical order of work and repairs with the least amount of handling and without any retracing or criss-crossing during the course of repairs. All work should be tested for tightness as the opportunity is offered during the course of repairs. In a small shop, it would be advisable to have the opening and boiling done in a separate room. A separate proving room should be provided as well as a separate room for the storage of all valuable stock on hand.

Meters to be tested and to receive ordinary repairs upon their removal from service should be handled separately from those undergoing extensive repairs. The proving of meters received from service and the proving and adjusting, topping, painting, etc., of meters from the meter repair shop could, however, be done by the same man or men, but when it is possible to do so, the two classes of work should be kept separate, for reasons of efficiency in completing the work and to enable the various costs to be obtained if required.

The number of meters that a meter repair shop is enabled to repair will depend upon the average size of the meters, the

percentages of the various kinds of repairs required, the skill of the mechanics and standard of work required, the policy of the company in regard to the work, the volume of work done and other details, all of which would vary under each situation.

Unless it was the practice to remove the meter fronts and backs on all meters that had been in service for a stated number of years, in order to examine the diaphragms, the amount of diaphragm repair work necessitated would not be affected, to any marked degree by the policies adopted by the various companies operating meter repair shops, inasmuch as only such work would be done otherwise as shown to be necessary, as determined by the various tests, without actually exposing the diaphragms. The length of time a diaphragm has been in service in a meter is no sure guide as to the condition of the diaphragm leather; some diaphragms may last 20 years, or longer, while others will need to be removed after one year's service. When a careful study of the condition of the diaphragms, and of the length of time they have been in service has been made, it is feasible to determine the length of service of the diaphragms in meters received at the meter repair shop, which warrants the removal of the meter fronts and backs without first making tests of any kind to determine their condition.

In one large meter repair shop, averaging 60,000 meters repaired per year, the average number of meters repaired per year per man, is 705. The fronts and backs are removed from about 95 per cent. of the meters entering the shop, without first making a test of the diaphragms. The average size of the meters in meter lights is 6.5 and the percentage of the repairs as follows: 87 per cent. new diaphragms, 12.5 per cent. clean and oil, 0.34 per cent. clean and adjust and 0.16 per cent. adjust. About 49 per cent. of the meters repaired are of the prepayment type.

In the city where the meter repair shop, referred to in the above, is located, five separate district shops are maintained to

test the meters upon their removal from service, and to determine what meters should be sent to the meter repair shop. In these shops, the meters are proved, adjusted, pressure, slow motion and burner, tested, receive general outside repairs and are painted. Under these conditions, each man in the district shops averages about 6,600 meters per year.

It is to be expected that the average number of meters, per man per year, that can be turned out of smaller repair shops than the one referred to in the above will be smaller, depending principally upon the volume of work, average size of meters, percentages of various kinds of repairs and efficiency of the repair shop organization. On the other hand, the average number of meters per man per year, handled in the ordinary way in the meter testing rooms, should be greater in most cases, owing to the fact that in most meter shops fewer operations and repairs are made to the meters removed from service.

The following references will be of service in the study of the question of meter repairs:

Gas Age, February 15, 1913, page 181.
"New York's Meter Repair Shop."

Account of the meter shop of the Consolidated Gas Co. in New York. Description of method of testing, repairing and handling of meters with numerous photographs of the various processes.

London Journal of Gas Lighting, November 8, 1910, page 407.
"The Repair of Gas Meters."

Account of method of handling gas meters in the shop and history of the meter in its passage through it, repairs made, etc.

Bureau of Information, American Gas Institute.
American Gas Light Journal, June 7, 1909, page 1025.

Comparative merits of piece work and day work in making meter repairs.

American Gas Light Journal, July 12, 1909, page 54.
"The Gas Meter."

Description of method of proving and repairing gas meters.

Progressive Age, March 1, 1909, page 196; March 15, 1909, page 246; May 1, 1909, page 378.

"Piece Work vs. Day Work in Meter Repairing"—Bureau of Information, American Gas Institute.

Answers from many correspondents giving cost of various parts of the repair under both systems, with divergent opinions.

Progressive Age, July 1, 1908, page 401.
"Maintenance of Gas Meters."

General article on the necessity for care in handling meters. Detailed instruction for making tests. Effect of various gases upon the diaphragms with general remarks upon dipping meters.

Light, October, 1907, page 378.
"The Springfield Meter Shop."

Description with photographs of the Springfield, Mass., meter shop, showing the various processes that meters pass through in testing and repairs.

1907 Proceedings American Gas Institute, Wrinkle Dept., page 384.
"Check System for Meter Repairs."

Each man repairing a meter is required to solder on a tag containing date of repairs and his initials.

Mr. A. M. Knapp (Yonkers, N. Y.): Mr. Otten made a remark on page 1192 in regard to meters being brought in, 'Bringing in meters for leaks, why not take the top off of it to start with? The meter may have been out on the district for a year or more, and if it is out that long the chances are when you come to use pressure at 1 pound or 1½ pounds to test for leaks, you find your stuffing box leaking, so you have to take the top off anyway, in order to repair the meter.'

Of course, if a meter has only been out one month or so, that may not have to be done. If a meter has been out on service two or three years, that meter ought to have the top taken off, the back plate removed and the diaphragms tested. A great many meters after they have been out two or three years are found to leak when the diaphragms are tested. A great many of the diaphragms are case-worn more or less, which means new diaphragms.

Page 1198 refers to meters being locked on the district, as follows:

"It would seem that with a knowledge of local conditions, the shop foreman could judge whether the premises from which

the supply of gas was ordered discontinued would be occupied again shortly, or whether it would be likely to remain vacant for some time."

If they are changing meters every five years for age, when a consumer moves and the meter has been set for four and one-half years, why not make out a remove instead of a lock? If the meter remains locked for three months, and is unlocked for a new consumer, it will have to be changed for age in a short time. One order in this case would do the work of three and the Company would be the gainer by it.

Then on page 1201: As all public service commissions and the majority of the companies allow meters to be set 2 per cent. slow, bringing a meter within one-half per cent. of correct is making a rather close test on it. If the meter was left, we will say, 100½, and the inspector testing that meter could very easily make a mistake in reading his dial or his pointer of an error of ½ per cent., and in the first district of New York, no meters are allowed to go out that are less—or I should say that do not register 100 per cent. or less, that is 100 or 102. If a meter registers 99½ in New York City on the first test, it is rejected. If it registers 100 per cent. or correct on the first test, it is given a second test. If it holds at that test, the meter is sealed, but if it does not hold at that test, and varies on its test, it will run by the inspector until they get a check test, and that meter is apt to be thrown out by the inspector. The meter ought to be run and adjusted so it will hold a test of 101, or preferably, 102. In that way, one will avoid having the inspectors throwing out a great many meters. Then the packing in the stuffing boxes may be tight, so if a meter is set at 100½, or ½ per cent. slow, when the inspector gets the meter and runs it down, he is very apt to find it 99½ or ½ per cent. fast.

In boiling out meters in potash, page 1204: "When a meter is repaired and a new diaphragm is put in, the meter is boiled out," Mr. Otten removes the dials. I do not see the necessity for this. Take a piece of tin and solder it over the dial, and

if the meter is carefully handled and not left in potash too long, the dial will not be discolored, and there will be no need of removing it. Resetting the dial has to be done very carefully in order that your index shaft is meshed properly with the crank worm.

Then he talks about draining meters. A new open top meter with no long channel running under the table has recently come on the market. The gas passes from the inlet into the meter above the table then through the valves. If this meter has been out on the district eight months or more, I think in opening it up, you will find that there is condensation on the table. If set in a warm place, that condensation merely dries out, leaving a chance for the table to rust. On all our open top meters, I think it would be advisable to at least take off the small round top, to make sure there is no condensation. They can be drained out by punching a hole in the side on the top of the table, but this is not advisable, for the more holes there are, the greater chance for leaks.

Mr. G. I. Vincent (Des Moines): My understanding is that the intent of papers of this type is to endeavor to ultimately standardize the distribution work, and the questions and comments I have to make are from that standpoint.

My first comment is on the discussion of meter connections on page 1196, which, in my opinion, is a subject that has been overlooked by many competent distribution men. I believe it is a vital point in our distribution system.

The use of lead connections or of any connection making it necessary to fasten a shelf to a wall to support a meter, has, in my mind, absolutely no excuse for being. Mr. Otten states that a shelf is necessary, which, of course, is true, but I venture to say that those of us who think we have shelves supporting all our meters would find, if we made a personal examination that we were very much mistaken. Possibly the shelves will be found, but they will not be supporting the meters A meter, particularly a prepaid meter, hanging by its columns is hardly the safest kind of an installation.

On page 1198, if the small piece of paper used on the index glass has a straight edge, and that edge is laid exactly over and parallel to the straight edge of the test hand after first slightly tapping the meter to take up the lost motion, it will show an angular movement of the test hand. This is so sensitive that a meter passing 1½ ft. an hour with a 2 ft. test hand will show a movement in 45 seconds.

Also, it is stated, "No attempt should be made to turn on the gas unless the fitter can personally enter all the rooms to be supplied, etc." I question whether this is entirely necessary.

Further along on page 1198, several references are made to locking meters when not in use. This is also a practice which I think can be profitably omitted. I believe that unused meters should only be allowed to remain set for a reasonable time, say not over 12 months. If no curb cocks are used, I believe that a cork thrust into the outlet connection will answer the purpose as well as more elaborate locking devices.

On page 1200, I think that more description of prover equipment would be advisable. The type of gauges with which the prover should be connected I believe should be specified, also whether the prover should be equipped with saturators, both on the inlet and outlet of the prover. My personal opinion is that there shoud be a water saturator on the inlet of the prover and a hydrocarbon saturator between the prover and the meter.

On page 1202, discussing the proving of prepayment meters it states that the valve should be closed by hand. I am of the opinion that the valve should be closed by gas.

On page 1205, there is incidentally a mention of five to seven years service before removal for periodical testing. These periods vary, I believe, from two to seven or eight years, while some small plants probably do not make any test at periodical intervals at all. Certainly if two years is too short and "indefinite" is too long, there should be one period which should be satisfactory under all normal conditions. I would suggest that five years is the proper length of time to allow meters to remain in service between tests.

Mr. F. W. Sargent (Indianapolis): I have read the foregoing paper with a great deal of interest, and found that the writer has dealt very thoroughly with the subject in considering the needs of a small gas company, and the following few remarks are offered as additional information:

Handling new meters, when received: If company numbers are to be given, it is much better to have them put on by the manufacturer, as this will tend to make a neater appearance and will lessen the cost to the purchaser.

Installation of meters: In selecting the location for the setting of a meter, we have found it good practice to locate the meter at the side of the cellar window, if possible, (in fact we will stretch a point to make it possible); that is, in cases where no curb stop is installed in the service. This will allow in case of emergency, quick access for removing the meter or shutting off the gas pressure, without entering the building. Of course, the swinging of the cellar window, if placed on hinges, will have to be taken into consideration in choosing this location. This condition would naturally come under the work of the service foreman, who should be instructed to follow this plan so as to enter his service at the best location with the least possible service extension inside of the building.

The use of a fiber washer, in place of the leather, so commonly used in meter connections, we have found to be a great improvement as a guard against leaks caused by shrinkage of the leather washer.

In testing out for leaks after the meter has been tried on a small flame as a test against non-registering, we have found the following "burner test" to be of the most efficient service to the gas company:

Your entire system is now filled with gas and the normal pressure is on. Light the nearest burner to your meter and note the size of the flame in your mind's eye, or by measurement, if you do not wish to risk the former. Then shut off your stop on the inlet of your meter. Allow your test to stand from three to ten minutes. Three minutes is ample time to show

an ordinary leak; 10 minutes will show absolutely "gas tight." Now light the same burner from which you took your test and note, on ignition, if the flame is exactly the same as it was at the start of your test, and allow your flame to burn out. If the flame does not burn out, you know that the core of your stop on the inlet to your meter is leaking gas, provided it had been properly turned off. If the flame was not the same as on your former test, this denotes the leak in the system that is under test. Immediately examine for leaks all of the work that has been installed for the meter set, and if no leak is found in this test, the leak must be in the other portion of the system tested. This test is very valuable, not only on first installation, but in connection with all setting and removing of meters and high bill complaints.

If electrolysis is present in the gas company's mains and services, the meter setter should take particular notice in making his meter connections, and report to his foreman, so that the company may take the proper course to eliminate it from the building. The meter setter should also note in every instance if combination fixtures or any electrical connection is joined to the gas system on which he is making his meter installation, and if he finds there is a marked current of electricity on the gas piping system, he should report this immediately to his foreman for further instructions. A great many consumers using gas for cooking, also have some form of water heater installation, and in most cases it will be found that the city water system is positive or negative to the gas company's system, and setting a meter under these conditions, not only increases the damage from electrolysis, but also the risk of an accident on the premises.

Mr. Walton Forstall (Philadelphia): The author speaks of the advantages to be derived from a company restricting its purchases to meters of one make. I know of a very large company which, for many years, has divided its meter purchases between only two makers. At the same time, it would seem that the meter makers should look forward ultimately to

standardizing meter dimensions, as experience in other lines of business would indicate that it is not to the advantage of the maker to manufacture articles which do not interchange with similar articles made by other factories. I hope that an attempt will be made next year to standardize meter connections as far as this may be possible.

With regard to the disposition of the meter after discontinuance of supply is ordered, such discontinuance, in Philadelphia, usually occurs as a result of a vacant house. We found by actual experience that the cost to the company of leaving meters shut off in vacant houses for two years, was less than the cost of removing a meter when shutting off gas. This because the number of removals we had to make at the end of two years was so small that the cost of these removals, added to the cost of excess meter investment, was not as great as the saving made in turning on the meters used again within the period of two years, instead of having to set new meters in each case. The number of meters in a shut-off condition at any one time is about 8 per cent. of the total meters in use.

When there is more than one meter on a service and, therefore, it is not possible to shut the curb cock, a solid swivel is inserted in the line of the shut-off meter, to prevent any unauthorized turn on. Under the Philadelphia condition, this seems to cover the situation that is often met in other locations by the use of a locked meter cock.

Mr. F. W. Stone (Ashtabula, O.): There is so much of value in the paper by Mr. Otten, and the subject is so thoroughly covered, that it is difficult to suggest anything further.

The chief difficulty and, at the same time, the most essential thing in connection with the meter work of a small town, is the securing of competent help. As a general thing, a good mechanic does not like to be bothered with too much bookkeeping—for this reason the records of a small company are apt to be loosely kept. I cannot commend too strongly the keeping of some form of meter record card. We find this of value not only in keeping a record of our meters, but also in

adjusting complaints with consumers. You have more confidence in your meters, and the consumer thinks you know what you are talking about if you can pull out a card and tell him the history and tests of his meter since it was purchased. It takes only a few minutes each day to keep these cards. We do not find it necessary to keep the meter record book, as shown in Figs. 6 and 7, when we have these cards. When a meter is brought into the shop, either by purchase or from service, the date, size, its number and reading are entered on a 3 x 5 card, which is placed in numerical order in a card index marked "stock." When a meter is set, condemned or otherwise removed from stock, the card for that meter is marked accordingly, and removed from the "stock" file. An inventory of meters in the shop is taken each month, and this inventory should agree in every particular, *i. e.,* sizes, meter numbers and readings, with the cards in the stock file. The used cards that have been taken out of the stock file, we file away for reference, but we have never had to look them up after the monthly balance was made.

We total the readings on the "stock" cards, and use them to help prove our consumers' ledgers. The general principle is that the grand total of all the meter readings in the plant, both in shop and in use, for the present month, less the grand total of the readings for the previous month, will equal the gas consumed. We find this method less work than the daily checking.

I suppose there will always be a difference in opinion as to the relative value of lead or iron connections for meters. We find no difficulty in hanging all sizes of tin meters up to the 20 light size, on iron pipe connections, without a shelf.

We do not find it necessary to require the fitter to personally enter each room to be supplied and test out each fixture. He is instructed to see that there is a good supply at the stove, and that the piping and connections are tight.

Too much stress cannot be laid on setting the meter in a desirable location. While it is all right to take care of the measuring mechanism of a meter and see that it registers ac-

curately, our experience would indicate that in a small plant, the case of the tin meter will rust out before the internal mechanism will wear out. In addition to setting them in a proper location, we find it desirable to have our meter readers inspect the meters periodically, say about once in two years, and report those in need of paint or where for any reason the connections would appear to put a strain on the meter.

In repairing meters, we find that even if a meter passes all of the tests and does not need the back and front removed, it is still of advantage to punch a hole in the side under the deck plate and spray with a syringe, a small quantity of oil on the top of the diaphragm. The diaphragm readily takes up the oil before it reaches the bottom.

Companies of about half the size of that mentioned in the paper can keep a meter repairer busy. An efficient man working alone, given occasional help in removing the paint from the meters before repairing and painting them again after repairs have been made, can put through the shop each week an average of 30 meters of all kinds and sizes.

Mr. E. W. Hammond (Kansas City, Mo.): The subject of repairing meters is one which has often come up, and about which very little has been made public, because the material for the subject is held by a comparatively small number of individuals, the majority of gas men being not so much interested in the manner of making repairs as they are in the results obtained after the work is done.

It is probably because this is true that a great many companies entrust their repairs to large repair shops, instead of doing the work for themselves. There is also to be considered the fact that the large shops can handle the work better than the small companies themselves, because they can specialize in the detail work.

Therefore, as a general proposition, the repairing of meters by small companies does not hold out a very bright prospect. The small companies, however, should give the subject thought

from the standpoint of knowing whether the repairs to their meters have been made properly or not.

The meter "history" card, showing locations and dates set and removed, combined with a "repair" card, showing tests and repair data, is very desirable, as it tells the whole story of the meter, and makes the picking out of "time limit" change meters, with their locations, an easy matter.

As this record is one which is in daily use, a book record of meter data, in which new meters are recorded as received, adds a double entry feature to the system, and in case of loss of a card, the book record is of value.

In Fig. 1 is shown a column for "name." This name would have to be changed for the same address, in many cases, and its use is questionable.

In the same figure are columns for "Ledger No." "Test No." and "Open" test, along with a very wide space for the "Nature and material" for repairs. The first three of these columns could possibly be done away with, and the latter made smaller to enter the repairs made in the following manner—"N. D." for "New Diaphragm," "C. & O." for "Clean and Oil," and "C. & A." for "Clean and Adjust."

Below is a form which would alter the above form in regard to the items mentioned, and in addition, give the cause for removal, which is useful in many cases:

Why Rem. or Tested	Proof on Receipt	Minor Tests and Remarks	Repairs Proof				Date Comp.
			Nature	By	%	By	

In testing new meters, or any meter in which recent repairs might cause a difference between the check and open tests, care should be used to test them at both check and open test rates of flow. In this connection, if check test caps are rated at 6 cu. ft. per hour per rated light-size of meter, the small provers (5 or 10 ft.) in many small companies' meter shops

will not pass through the connections enough gas or air to make the open test properly on large capacity meters. Six cu. ft. per hour per rated light-size of meter is a common rating for these check test caps, but when testing or adjusting large meters on check and open tests with small provers, caps with lower ratings must be used if difference in rates of flow are to be obtained and possible large errors in big meters are to be avoided.

Trucks such as are proposed are useful to transport meters in large shops where distances are great, but their use in small shops is limited. In stacking meters without trucks, they can be run five or six high, which adds 25 to 50 per cent. of stock for a given floor space over what can be loaded on the truck, aside from a certain loss of space on shelves with different sizes.

There are several objections to the placing on meters by fitters, a tag which is to be used for recording meter tests, this tag remaining on until the fitter sets the meter. First, the fitters have to spend time on this work, which can be better done by a clerk. Second, if the tag remains on the meter until it is set, the record of proof, etc., taken from this tag does not get to the office until some time after it would if the tag was detached and sent in as soon as the meter tests are recorded. Third, additional handling of this tag by fitters adds to the dirt on the tag, making it harder to read, and also increases the number of tags liable to be lost.

A form of tag for recording is shown on page 1238.

This tag is plain, gives a space for proof after adjusting meter, provides for pressure testing, and the delicate operation of packing stuffing boxes when necessary. Under "Remarks," for which a generous space is provided, details of leaks, tampering, jerky troubles, etc., are noted, the last two items being taken care of by the foreman personally.

If we are to take the opinions of men who have investigated the subject of rate making, we should not add to our expense by setting meters in rooms on different floors of light-house-

METER TEST CARD

Co.'s No.	Size
Maker's No.	Index
Date Received	

"SAFETY FIRST"

Guard against personal injury.

When working on meters one should feel his responsibility and do good work, so that when repaired the meters will not leak and cause accidents or trouble.

(*Reverse side*)

WORK	RESULT	DONE BY
Check Test		
Packed Boxes		
Pressure Test on Bottom		
Slow Motion Test		
Adjusted to		
Pressure Test on Bottom and Top		

REMARKS:

FORM N. G. 192

keeping flats, and moreover the additional danger involved by this practice disregards the slogan "Safety First."

One of the most interesting parts of meter work is the handling of meters to prevent leaks at inlet and outlet screws not riveted to the meter sides. Our experience has been that a single rivet through the screw and column adds little to the strength of the joint, while the screw with a rivet through a lug on either side holding fast to the meter, is much better. However, "Riveted screws" is not the final word on this subject, as some of these have broken. The type of connection used, while having its effect, does not, in my opinion, have as much to do with strained screws as do the individuals who connect and disconnect the meters, the conditions under which they work, the weight of risers, etc.

To test a meter, after it has been connected to the house piping, for registration on a small flame, with the intention of then using the meter to show any leaks in the piping, is open to the possible chance of the piping leaking during the test of the meter on the small flame, and the meter not being given an accurate test.

The ideal way would be to place on the meter outlet a cap which has a very small hole in it, and thus test the meter, independent of the house pipes, for the time of a complete revolution. This affords certain knowledge of the accuracy of the meter. This all takes considerable time, and in the majority of cases will be found a hard practice to put into use and get the desired results.

"Personally entering into all of the rooms to be supplied, to see that conditions are satisfactory and gas out of the piping," is another rule which is not followed by the majority of the men with whom I have come in contact. If they make a "turn on" test, and find the house pipes tight, they spend very little time in purging the lines. If they spent some time on inspection of each appliance, they might develop new business where it is being pushed, and avoid accidents due to such matters as old rubber tubes leaking, etc.

Instead of pasting stickers to meters to identify the consumer supplied, a linen or other lasting form of tag, attached with non-rusting wire to the house riser close to the meter, and showing the part or parts of the building supplied, will be found more serviceable, as the consumers' names change, and the meters are often removed, and with them, the record.

By detaching the test tag as soon as the tests are recorded, there will be found but very little use for "special test tags," as all tests reach the office in a short time on the usual test tag.

In determining if the meter registers on the passage of small volumes of gas, simply a "noticeable movement of proving head pointer" will not O. K. the meter on all quarters or on all points in the cycle of operation of the meter movement, while enough time to complete a revolution would insure this check.

A burner adjusted to burn the rate of flow used in making the small flame test will save time in turning down an individual burner.

The author says all meters removed for "age" should be opened up or diaphragms repaired. I would like to know if this refers to three, four or five year "time limit" change, or to meters which have been in service a certain number of years without diaphragm repairs. If it refers to "time limit" changes, as indicated in the next to the last paragraph of the paper, the opening up of these meters to the diaphragms does not seem to be warranted, in view of past experience as to the life of diaphragms.

If it is desired to test these diaphragms further than by making small flame tests on the meters, it looks as though an effort should be made to take off the "back plate" over the valves and test the diaphragms through the valve ports, as in making a "clean and adjust" repair.

It is not necessary to take out indexes, and this method is likely to cause mixing up of indexes, and so make void any check on errors in meter readings, aside from the loss of time spent in removing the indexes.

Mr. A. G. Treadway (Detroit): I would like to know how many meters the automobile on page 1194 can carry? It appears to me that not more than ten could be taken out with a delivery box of this description. We would not use an automobile for setting 10 meters, unless the meters were to be carried to outlying districts five miles away and further. This automobile would be profitable if it were used perhaps for setting meters, inspection work and general complaints, but for setting meters alone, we would not consider an automobile of that capacity an economical proposition, because it would cost at best two or three times as much as a horse and wagon, and with the few meters that it would be capable of carrying, would bring the expense of setting each meter very high.

I would like to know if there is anyone here who knows what this machine actually does. We have gone into automobile delivery quite thoroughly and have used a number of different kinds of machines, and we have considered this machine, but it is our opinion at the present time that it would be too light for profitable employment, unless used with a trailer.

Regarding the question of using shelves for meters, it seems to be the opinion that they are absolutely necessary. In Detroit, we have over 125,000 meters in use, and we have not a shelf in the whole city that I know of. We have been hanging meters singly, or on manifolds, without a shelf of any kind, and as our leaks are not excessive, we would not consider putting in shelves. Every time an additional operation like that is added to a meter setter's work, the time of setting the meters is undoubtedly increased appreciably.

The Chairman: Is there any further discussion? If not Mr. F. M. Roberts will try to answer whatever questions may have been propounded.

Mr. Castor: Before Mr. Roberts answers, I would like to take exception to the statement made by Mr. Vincent, to the effect that the gas should be saturated as it passes out of the

meter provers. If saturated gas is used as the medium for proving meters, it should be thoroughly saturated before it enters the provers, and every precaution should be observed to insure that it does not change in volume while in the provers, while passing from the provers to the meters, or while passing through the meters under test.

Mr. F. M. Roberts (Haverhill, Mass.): I will not attempt to answer all the questions, but there are one or two things I would like to take up. In the first place, this paper was not written with the intention of standardizing meter service. It was written, however, with the intention of being a guide to any small company that is about to establish its own repair shop. We are not perfect at all and do not pretend to be, but we have built up this small meter shop and found it to be a profitable investment.

Mr. Treadway spoke about the automobile. That is so constructed that we can carry from 12 to 15 meters, and in a company the size of ours, a man who is handling the setting and removal of meters also does little odd jobs. It has proven to be a very good thing. Our town is not very much spread out, and he gets into the shop at least twice a day and often three times. If he is on the outskirts and runs out of work, he telephones. That does not give him a chance to set any meters, but we may have some adjustments or orders that he can do on the way in.

The other questions I will not attempt to answer because our time is limited.

The Chairman: The next paper on the program is "The Improvement of Distribution Employees," by Mr. C. E. Reinicker, of Chicago. Will Mr. Vincent take the chair?

THE IMPROVEMENT OF DISTRIBUTION EMPLOYEES.

Introduction.

The subject of this paper is one indicative of great possi-

bilities, and in the endeavor to make it of real value to the gas industry, I have felt no hesitancy in making use of ideas and various methods of education at present prevalent in several companies. I have also used as a nucleus, a paper prepared by me and read before the Illinois Gas Association, in 1913.

It is hoped by this course that to those who have not given the idea of the education of their employees much thought, this paper will serve as an inspiration; to those who have the intention to begin such work, it may serve as a guide, and to those who are engaged in this work it may serve as a stimulus to accomplish even greater things.

Each distribution man who reads this paper has some definite idea on this subject, different from any herein contained, and it is to be hoped that the discussion of this important item of the life and vitality of our industry will be most complete, so that we will have a presentation of the matter covering all of its phases.

It is unfortunate that we of the operating end of the industry are not in such a position that we can avail ourselves of a "Board of Educational Control." similar to that existent in the Commercial Association. The time may come when such an organization will become a possibility, but at the present time I am not sufficient prophet to fortell when.

The great reason for our not having such an establishment lies, in the opinion of the writer, in the fact that we are dealing with a very different class of employe than the Commercial Course embraces. Our men, in many cases, have to be taught the actual manipulation of tools, or the definite method to be employed in the connecting of appliances, in each separate company. They must be actually shown, and this cannot be accomplished by a correspondence course such as would be laid out if modeled after that of the Commercial Association. While it is absolutely necessary for the successful salesman to know something of distribution methods, he can know them

far more superficially than does the distribution man. Therefore, each executive will be required to work out his own practice, at the present time, as far as the education of his distribution men is concerned, although he can be greatly helped by an investigation of the experience of others who have worked along similar lines. It has come to my attention, however, that there is an organization which will advise those companies that are its members, in the proper starting of their educational work. This organization, known as "The National Association of Corporation Schools," embraces all industries. This may provide for some men the material needed, and an investigation of its methods is sure to result in information of great value being obtained.

In presenting this paper, the writer wishes it to be clearly understood that it does not recommend the superfluous teaching of workmen along lines that will do them no good, nor is it the endeavor to inflict a college education upon them. The paper does recommend, however, the proper training, by some method, of the men who make up the distribution organization of a gas company, so that they may execute the work laid out for them, promptly and well.

The Necessity of Education.

There are two fundamental objects to be gained in the educating of men of the Distribution Department. First, that they may become of increased capacity in the work of the company, and second, that by this increased capability, they may, at the same time, become of more worth to themselves. In order to become of the highest efficiency to the company and to the public, they must be trained in two ways, namely, in the "service" sense and in the mechanical sense. While training the men to the company's viewpoints, they must also be taught to become more self-esteeming, or in other words, they must be shown how to help themselves so that they may become better and more useful to themselves, and in this way

they will become more useful citizens by the awakening in them of their sense of duty to the community.

Education as Regards "Service."

The ultimate end for which all public service corporations are constantly striving is the providing of the most efficient result in the performing of the service they undertake to render. The energy of the whole organization should be directed toward this purpose, for it is largely upon service rendered that the very life of the undertaking is dependent. This does not mean that the company should stultify itself to cater to the whims of an exacting individual, but it should render the best service possible on each occasion.

This means that the points of contact between the company and the public be carefully watched, thus prescribing that the men of the Distribution Department be taught this attitude of "service" with all that the word implies. We must make these men realize one important, even solemn, point, namely, that when they are on the work of the company, each individual is the *gas company*. He must be made to realize his importance in the general scheme of producing efficient service, and his dormant sense of position awakened. Once awakened, the future possibilities of development come from within.

The public does not respect our advertising, which sets forth the desire to provide efficient service; it does not know of, nor does it care for the attitude of, our managers or officers, if the men whom it meets during the daily course of business do not live up to these tenets. The public sees and judges the company entirely by these individuals' actions; therefore, our reputations are largely in the hands of a force of men who, as individuals, may not care whether the company makes good or not, but who must be taught, retaught and taught again, that as long as they are in our employ, "service" is the most important item, the keynote in the work of a Public "Service" Corporation.

In order to provide a fitting climax to the argument for

this necessity, statements made by two gentlemen, one the president of a great Public Service Corporation and the other the chairman of a State Utilities Commission, will not be amiss. The president of the Consolidated Gas Company of New York made reference to the important factor in this development in the sphere of gas activity, in his address delivered at the recent centenary celebration. Mr. Cortelyou said in part:

"The shortcomings of a supply as to pressure, candle-power efficiency and other essentials, are apt to be a matter of moment, and when remedied in a gracious manner leave no rankling; but the shortcomings which are evident in poor service, brought about by inattention, neglect or slipshod methods are not easily effaced from the consumer's mind; so I say that the word "Service" should be writ large in the mind of every worker for a Public Service Corporation."

Chairman Duncan, of the Indiana Commission, states the same necessity in the following words:

"Of all the complaints which come to the Commission, few are against the conduct of the managers of the companies. The chief complaints arise from the insolence of the employees. School your employes in kindness and consideration towards the public. This will do much to bring the friendliness of the public to your companies. Treat the people with consideration and civility and you will remove one of the best grounded reasons for complaints against you. I suggest that the larger companies establish schools of instruction for employes.

"Petty incivilities and slight neglects are not permitted by employes of private mercantile enterprises, because a great deal depends upon first impressions, and these are favorable or unfavorable according to the good manners and cordiality of those in charge. Naturally the managers demand that the first impression shall be favorable. Public utilities companies should demand the same thing of their employes. Civility is one of the essentials of success in business, private or public."

Unless we have our men trained in this fundamental idea of "Service," the company is going to be the loser, and, therefore, no matter how far each company may care to advance in an educational scheme, the distribution men of every company, large or small, must be taught this necessary part of our duty towards the public.

Education in the Mechanical Sense.

Under the preceding heading we have been dealing with a training which is necessary to all branches of Distribution Department work, while under the present heading we will treat of the necessity of training in a particular way and applicable, in the main, to the fitting work. Although the street man undoubtedly requires some training in a mechanical sense, his work is of a class entirely different from that of the fitter. This is particularly true of the larger companies, for in the smaller companies, it may be that a few men do both fitting and street work. In this event the subject matter of this section will be as applicable to the so-called street man as it is to the fitter. For the purpose of this paper, however, the fitters are considered to be the most important element of the distribution organization. These men are more constantly in touch with the public, and are on a more intimate footing with it than are the men of any other department. Therefore, it is upon this department that most of the responsibility for a satisfied or dissatisfied public rests.

In the fitting work of the gas industry we require that the fitter shall be different from the usual conception of the term. In addition to his mechanical skill, he must have an intimate knowledge of gas, or in other words, he must be a "gas man." This one reason is why so many fitters with fair mechanical skill are unable to hold positions with a gas company after they obtain them. Our men in the fitting department should, therefore, be "gas men" and in addition, should be able to do work according to the best mechanical practice, since we well know how extremely critical the average person is when work

is being done on the premises. Unless we can satisfactorily comply with all requirements in this respect, the good work of other departments can be completely overshadowed and nullified through carelessness or incompetence in the Distribution Department.

This brings up the necessity of close co-operation on the part of the Distribution Department with the other departments of the organization. Too often we find the Distribution Department hostile towards the others, and interfering with the best service to the consumers by resorting to small and irritating quibblings over points too minute to be noticeable to one in authority. We of the Distribution Department must not forget that we are dependent upon the Commercial Department for our existence, and the more we can aid this department in its endeavor to satisfy customers and increase business, just so much more work we will have.

There may be many justifiable kicks permissible from the distribution man regarding promises made to customers as to the delivery or connecting of appliances, etc., but with harmony existing between these departments, much friction can be avoided and the good of the service advanced. Therefore, in this necessity for the production of mechanical efficiency, our men must learn that co-operation with other departments will greatly aid in this effort, and produce a well oiled machine wherein all parts operate in harmony.

In addition to this demand for satisfactory work, we are constantly reminded of the necessity of good mechanical work from the standpoint of economy. Economy in operation cannot be attained save by having the work carried out in an efficient manner, and the only way that men can so carry out the work is by being taught, either by many years of experience, or by some definite educational scheme. We must at least acknowledge that by the latter method, the fundamental principles can be much more accurately and quickly mastered, which is in itself of great value to the company. There can be no doubt but that in the end, the best education that a man can receive

will be that which is derived from constant contact with his work. Experience always has been and always will be the best teacher, and by making mistakes, a man will grow proficient, if he be of the right caliber, because such a man will profit by his mistakes.

In the business of a gas company, however, we cannot afford to make many mistakes at the expense of the customer and the good will existing towards the company. Furthermore, mistakes cost money, and, therefore, it behooves us to eliminate as many of them as possible, and by the proper teaching of the fundamental principles of the work, we can materially reduce these sources of worry and loss of revenue.

Speaking in a figurative sense, we know that if it were possible, the owners of the various gas companies would carry on all of the actual operations of the companies themselves, so that they could then be sure that the work was being carried on as cheaply and as expeditiously as possible. This being manifestly impossible, these owners have been compelled to trust the carrying out of the various operations to other men, their managers, engineers, superintendents, etc., who in turn have working under their direction, necessary forces of men for the proper conduct of business. It is clearly evident, therefore, that these latter are the units upon whom the owner is eventually dependent for at least a portion of his profits.

The owner is, therefore, entrusting his business to those to whom he pays his money to do his work, and in many cases, he comes into personal contact with only a few of his department heads. These are by training or experience best able to carry out his wishes, or policy, in a manner determined by best practice. He trusts these superiors to produce desired results and to conduct the enterprise in the same efficient manner as he would himself. Therefore, the men occupying these positions of responsibility must see to it that the force under them operates as thoroughly and as economically as possible, and they must inform that force of the best manner of conducting that work in accordance with the policy of the

undertaking, since this is the only way that the workmen have of becoming acquainted with those policies.

In the largest companies there are many departments each doing one thing, while in the smallest, a few men may be engaged in all classes of work. In each case the result is the same; each individual must be well equipped with the knowledge of the work which he is called upon to accomplish. On the ability of the workman the whole organization must stand, for if one man is weak, just so far will the operation of the company be impeded and the efficiency lowered, for no matter how clever a department head may be, he is absolutely helpless if he has a body of men under him who cannot carry out his ideas in an efficient manner.

Summary of Two Preceding Headings.

I have endeavored in the two preceding sections to impress upon those in charge of distribution work, the necessity of educating the men forming their department in two ways:

First (and most important): along lines of rendering "Service."

Second: along lines of perfecting mechanical work.

President Mulholland, of the Indiana Gas Association, in his inaugural address of 1912, summarized this need in the following words:

"Are we not operating our business in restraint of our own trade by failure to see that the company has only such employees in office, works, shops, fittings, maintenance, and street departments who are always striving to furnish the best attention, best quality of product, most efficient work and service, and best and most courteous treatment and earnest consideration to and of the necessities of our patrons, anticipating their requirements whenever and wherever possible? In a word, are we not conducting our business in restraint of our own trade by failing to bend, not only our personal energy, but by not insisting upon all employes doing the same, to the end

that we may be looked upon as an institution that furnishes not only gas, but service also, thereby securing the reputation of being a business in which profits are legitimate, because we give full value in the gas and service furnished?"

Necessity of Education from Viewpoint of the Individual.

Heretofore, many of us have been looking at this question of education entirely from the viewpoint of the benefits accruing to the company. There is, however, another phase of the benefits resulting from this endeavor, namely, the benefit to the men themselves.

In this connection we must recognize the existence of men who are in the class of unskilled labor through lack of opportunity or foresight, or due to other circumstances not under their control. The ranks of this unskilled and low grade labor are overcrowded, and industry in general, which includes the gas undertaking, suffers for want of skilled workmen. Many by disposition or make-up have no desire to better themselves, being content to drift here and there, irresponsible, untrustworthy and often vicious. Others are not capable, although faithful and willing plodders, and have to find their livelihood in such unskilled labor. On the other hand, many can be trained in a comparatively short time to semi-skilled or skilled special labor. Out of this situation has grown the demand for a system of education which shall meet the needs of the workers in the industrial classes, and it is with this education applied to the men of the distribution department, that we have to deal.

The average unskilled laborer is a "floater," or he may even be a parasite, having no responsibilities and being worthless to the community. His moral standards are low and his viewpoints are distorted. While an education may not place this man on a plane so that he realizes, even to some extent, his responsibilities to society, yet we all know that we have little real trouble with the industrious and thrifty workman, a

condition largely brought about through the agency of some form of education. With this increased responsibility, comes a more satisfied sense of position, a realization that "All men are not born to rule." Unfortunately this satisfied class is in the great minority, and as a result, the state of modern industry is one of unrest, an unrest brought about by the profound discontent on the part of the great majority of the laboring people.

We have only to read the daily press to realize the truth of this assertion. Through this agency the vigorous discontent is brought to our attention, and the employing class cannot sit idle and watch the tide of events roll by, else they be overwhelmed themselves. The average laboring man most emphatically declares that the enormous advances in the industrial world have not brought about a proportionate advance in his own position. However, the fact remains, borne out by trustworthy comparison, that industrious workmen are better off in general welfare in the present age, and also that wages of labor have undeniably risen during the last half century, but, notwithstanding these statements, wages have not increased proportionally with the increased demands made by labor.

The laboring class clamor for higher wages and shorter hours, and when we consider that its physical effort is all it has to offer, we must agree that it has a right to as high a rate of return for its only product as is equitable and just with the demand made upon this product. The outcome of this demand has been the Labor Union with its basic principle for good, and also with its attendant evils. The employer, on the other hand, meets this demand by a perfectly true statement concerning the increasing cost of production, the gradual reduction of profits, and, in particularly pessimistic moods, points to inevitable bankruptcy if the advance in wages equals the demands of labor.

At best there is but a condition of armed neutrality existing

between employer and employee, and this state is often ruptured by strikes and lockouts. During the past 30 years, something like 17,000,000 people have been involved in strikes or lockouts, a condition which is at the best depressing. Dr. Charles W. Eliot characterizes this attitude as follows:

"The industrial situation in this country, and, indeed, in the world at large, has not improved during the last 25 years. On the contrary, it has become more exasperated and dangerous."

Although the gas industry as a whole has been remarkably free from labor difficulties, I have presented these figures to show that with this great number of persons affected, we are not in any position to positively state that we will not become involved, since we have in our employ, and are constantly employing, the same type of workingman that is being employed elsewhere, and it behooves us to take some measures to guard against this possibility. The result of such trouble to the gas industry should be seriously considered, and sober reflection given to the solving of this question.

Notwithstanding the present unsatisfactory outlook, I feel that at some future time, conditions will adjust themselves so that labor will respond favorably to the efforts made in its behalf in the establishment of welfare work and pensions, the betterment of surroundings in a physical sense, etc. Through the aid of a proper education will this end be hastened, because then these men will begin to realize their duty to society and their responsibilities in their sphere of activity. It is not easy to work as a machine, to be a mere cog in a machine, when there is no outlook nor any broadening possibilities afforded. This narrow outlook has a deadening effect upon individual efficiency, turning an ordinarily sober, industrious man into a discontented, dangerous element in our organization. If we can make these men realize that their work is not a meaningless routine, but an important item in our operation, we have a better organization, and an organization that is

loyal to the company not only during the course of business, but also at all other times.

Money Value Involved.

In the previous sections this question has been treated from a more or less altruistic point of view, but now it will be considered from the angle of the money involved.

In every live company, be it large or small, there is, in proportion to the size of the undertaking, always large sums of money involved in the payroll, and this labor charge is from 10 to 15 per cent. of the total manufacturing and distribution cost of each 1,000 cu. ft. of gas.

Wherever possible, mechanical movements have replaced human endeavor in the production of the output, and new and improved mechanical agencies are being advanced every day, since science and invention are continually striving for the ultimate perfect state. While these new and better agents may develop several hundred per cent. more efficiency than did the machines they replaced, and many hundred per cent. more than would be possible to obtain from hand labor, yet we positively know that the most perfect mechanical movement in the market to-day will not increase in efficiency in a steady ratio, although by improvement, it may be increased for the time being. When the efficiency of a mechanical unit lowers and decreases, the progressive operator then casts about for some other machine which will do more efficient work. Notwithstanding this, we are still largely dependent upon human endeavor in our business, and the day is just dawning when this important adjunct is being given the consideration it deserves.

Although it is extremely difficult to place an actual value on the efficiency of men, yet we know accurately and absolutely the amount of money represented in them. We have large sums of money invested in these human agents, who occupy a position greatly superior in importance to our mechanical

agents, and yet this branch is much less efficient than are our machines. In the face of this we have, until recently, watched unseeingly and uninterestedly, large sums of money put into a poor investment, an investment paying interest not in dollars and cents, but in labor and endeavor.

The following figures are most conservative, yet they should produce a profound effect if they are carefully thought out. The man to whom we pay $50.00 per month is usually of a very low grade, yet the investment at 4 per cent., which pays this man his yearly salary, is $15,000.00. The $75.00 per month man represents $23,000.00, and so on. We know that a 1,000,000 cu. ft. holder costs approximately $100,000.00, yet do we realize that the money invested to pay the salaries of four men whose monthly wage is $75.00, would very nearly pay for this holder? It is clearly advisable, that we try to increase the efficiency of this human element in our business, since this is the only type of *machine* that is capable of a steady increase in efficiency, and in which the money spent draws an ever growing interest in service and endeavor.

Therefore, the size of this investment alone demands an increased efficiency on the part of those who are on our pay rolls. We must provide these individuals with something they did not have before, that something which will make them more valuable to themselves and to us, and we must lay out the path and plant the necessary sign posts to show them the way they must go, so that there will be no mis-directed effort or lost motion in this important work.

Selecting the Men for the Work.

Having proved the necessity of educating the men, we can now turn our attention to the building of our organization, that *force* with which we must properly carry out the policies laid down for us. The first and foremost step to be taken in this work lies in the obtaining of the proper timber; therefore, in the hiring of our men, care must be used.

In other branches of industry, the employer is becoming more and more prone to hire those men who have strong qualifications for, rather than experience in, that particular line. This should hold true in the gas industry, for if a man has ability and exhibits a willingness to work, he can be taught, while laziness, dishonesty or some existing prejudice, will nullify the best experience.

In the determination of an applicant's fitness, every employer should have certain standards of requirements, and by these standards he should form his opinions before selecting his men. These standards should involve a fundamental and intimate knowledge of the requirements of the situation, together with a fairly thorough understanding of the applicant. This latter knowledge can be gained by making a man analyze himself, somewhat after the suggestion of Mr. Gustave A. Blumenthal, who has prepared, in one of his writings, a list of questions embracing the main facts of an applicant's life, and which will be of great interest to those engaged in the hiring of men.

In the relative determination of a man's ability, the following short lists prepared by Mr. Hugh Chalmers, President, Chalmers Motor Company, and Mr. F. W. Taylor, efficiency engineer, may be of service:

Chalmers	Taylor
1. Health.	1. Health.
2. Honesty.	2. Honesty.
3. Ability.	3. Brains.
4. Initiative.	4. Grit.
5. Knowledge of business.	5. Special knowledge, manual dexterity, strength, etc.
6. Tact.	6. Tact.
7. Industry.	7. Energy.
8. Open mindedness.	8. Judgment.
9. Sincerity.	9. Education.
10. Enthusiasm.	

With the relative unimportance of a knowledge of the work

in mind, it becomes evident, therefore, that the rock bottom, fundamental necessity in the desired building up of an organization lies in the employment of men who have certain requirements necessary for the work in which they are to be engaged, not by guess work, but by some definite or preconceived plan. That they must have a reasonable amount of latent capability, is obvious, since it is manifestly impossible to direct the energy of an individual, if that individual has no aptitude for the work. The proposition then narrows itself down to that of obtaining men who are capable of being educated, or those who, while they may know the business as carried on in some other locality, are willing to be taught the methods determined by the employing concern as being the best. The live superintendent has no use for the "Old dog that cannot be taught new tricks" or, for that matter, for the young man who is not willing to learn.

I do not think that too much stress can be laid upon the hiring of our men. The question is a vital one and must be handled with the greatest care and consideration. With a weak employing agency, be it in the shops or office, the whole organization will give trouble, since, as the employing medium judges and selects, so will the undertaking succeed. This phase of our work may be likened to the foundation construction of a building. In an address on foundations, to a class in one of the famous engineering schools, an engineer made this statement: "Make them strong, and then make them damn strong." His meaning is plain, and we can adapt this principle to our own work, since with a strong foundation composed of good reliable men, we can closely approach perfection with our organization.

In the usual run of business, there is not much thought given to the importance of a proper medium for the employing of men. I do not necessarily mean a person whose whole duty is in this work, but any one who is responsible for the hiring of men. This medium or agent must look upon this work as a possibility for great things and not as something

to be avoided, to be slighted. It is his work to move human chessmen on the board, to produce the combinations as regards temperament, characteristics, disposition, etc., which will create efficiency. This requires more than a haphazard, snap judgment sort of a choice and, therefore, the man who does this work, especially in a large organization, should be particularly fitted for it.

He should understand men, and should be broad and sympathetic, willing to put aside his personal prejudice for the sake of the good of the company. He should be of sound judgment, keen, alert and thorough in the obtaining of information. He should not try to bully the applicant, but should possess tact, and realize that in many cases, the obtaining of a real job is an epoch in the life of a man, and for this reason the employing agent should not be inconsiderate or unkind, and should realize that he is dealing with a human being. These may seem to make an impossible combination, but when one stops to consider, it is realized that the undertaking in which contentment and efficiency are paramount, is presided over by such an employing agency

With these qualifications on the part of the employing agent, and with some definite preconceived plan worked out for the hiring of the men and their advancement, primarily from the standpoint of ability, the organization must succeed. In large companies, I believe that the chief aid to this work rests in the creation of a central employment bureau which shall have control of the hiring and promotion of the men. By this step becomes possible the organizing of a clearing house for all departments and a means of standardizing advancement, etc., among employees of the corporation. I do not believe, however, in an absolute rigid standardization which may result from a system such as this, if in such an event, ability is likely to become subordinated to age requirements and length of service. Manifestly this is wrong since it will absolutely stifle initiative; therefore, any idea which has for its aim the advancement of men, must be constructed on the principle that

ability or fitness for a position by virtue of training, should be given full weight. In addition, there should be special dispensations for men working along particular lines, and to those who cannot be classified as to occupations, etc., since here again are the necessary exceptions to any hard and fast rule laid down for advancement.

In this connection it might be well to describe the system for the hiring and advancement of men which is in operation in the Peoples Gas Light and Coke Company.

For this purpose the employes of this company are divided into two classes, salaried, or those men who are paid by the month, and wage earners, or those who are paid by the day. The Merit system, therefore, applies to the salaried men who are in the district shops, manufacturing stations, chemical laboratories, etc.

No outside persons are engaged for any salaried positions, unless the position is highly specialized or technical in character. The ordinary rank and file begin service as messengers either in the main office or in the bill delivery department.

All salaried positions are listed on file cards, and fall into one of seven predetermined grades, this grade establishing the minimum and maximum salaries for this position. When a vacancy occurs, all employees in the same grade or in the next one beneath that in which the vacancy exists, are eligible for advancement, regardless of the department. Promotion depends on three factors, namely, merit, length of service and the grade which the man occupies at the time. When all other qualifications are equal, candidates for promotion are ranked by length of service.

In the Distribution Department the Merit system applies to all clerks, and to the operating force on a monthly basis. This includes shop and fitters' foremen, some main foremen, and inspectors. The various superintendents of the divisions have the power to hire and advance all men who are not salaried. They also recommend to the Merit board any change in rate or position which falls under their jurisdiction.

In Rochester, a bureau, somewhat along the same lines, has recently been established, "which although new is already making its advantages felt in all departments, even though it does not take away from the general foremen of the street and shop departments the power to hire the employees of his department, but it has been found rather as an aid to procure easily and quickly the special kind of men he may desire at any time. The bureau enrolls the names and addresses of individuals who are looking for work, the kind of work they are able to do, and in fact, a general record of them and their ability. In case a man is hired by the shop or street department, he must be examined by a physician."

Some methods similar to those briefly outlined in the preceding paragraphs help to avoid the danger of forgetting a man, letting him become buried and pass through the various stages of dry rot. Many men of undoubted ability have been forgotten for such a long time that when they are suddenly projected into a position of responsibility, they are unable to hold it, through fear rather than from lack of ability.

In concluding the subject matter under this heading, we must realize that a good man means many dollars earned by the employing organization, while an unfit or inefficient one will cause a corresponding loss.

Necessity for Medical Examination.

We should start each man with the goal before him of at least becoming a foreman, and all applicants should be looked upon as future foremen or superintendents, and chosen with this in mind. For this reason, after starting to work with this goal in view, as few of our men as possible should be disqualified by disease, from obtaining these or similar positions, since lack of health is one of the possible stumbling blocks which we control.

Every employing expert insists that health is one of the first requisites for a successful man; therefore, it behooves the company to insist upon some kind of a medical examination. There does not seem to be any possible reason for opposing

such a view as this, but I have no doubt that there are companies that have no medical examination of applicants. In order to facilitate this work, it is suggested that the employees be divided into two classes, permanent and temporary; thus taking care of the laborers who are hired for the summer work, and who will be laid off at its completion.

It would be clearly a loss of time and money to institute an examination of all such employees, because they are not of sufficient importance, but all those men who expect to stay with the company, namely, fitters, helpers, street mechanics, caulkers and permanent laborers, such as yard men, janitors, etc., should be subjected to a rigid examination, and if they are not physically fit, they should be rejected. If the employing company has a welfare or pension system, the report should be more elaborate than were it merely on an examination for employment in a company without these benefits, but in any case, the important items should be well covered.

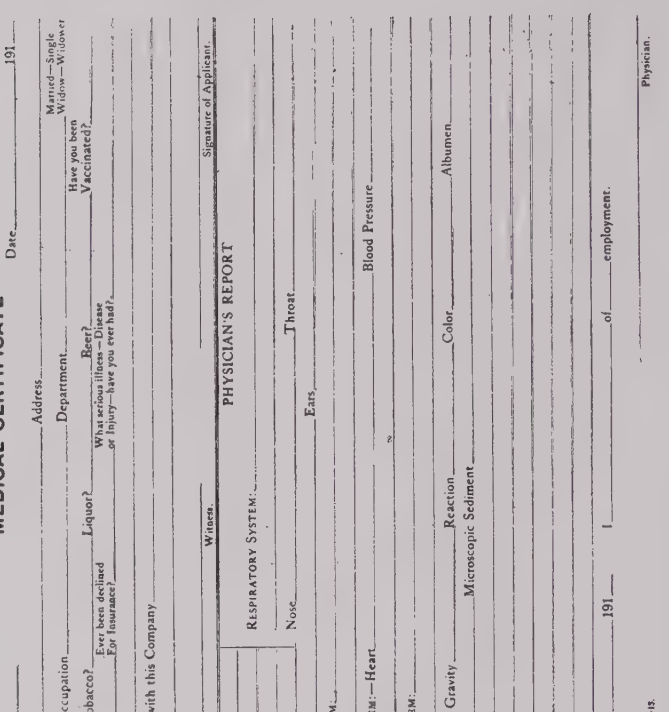
I am confident that the progressive operator realizes that money spent in this way is money gained in efficiency, since he can be reasonably sure that his men will be able to stand the strain of the work which they are called upon to do, and that there will not be constantly interrupted service. If the disease from which one man suffers is a contagious one, imagine the physical risk to which are subjected the men associated with him! There is another phase of the question, a diseased body often means a diseased mind, and a diseased mind may mean an agitator, stirring up discontent and creating discord.

In states governed by workmen's compensation acts, such an examination becomes a necessity, since it may prevent an injury due to some hereditary or acquired weakness. As an instance, it may detect the case of some hidden disease that will bring on an epileptic fit and cause the man to fall into a machine. In such states, therefore, the companies are even more vitally interested in insuring the health of the working force.

Fig. 1 is a form of medical examination blank that is

used by one large company. This phase will be dealt with later under the heading of "Welfare and Pensions."

The selecting of physically fit men, therefore, becomes a



MEDICAL CERTIFICATE

No. _____ Date _____ 191__

Name _____ Address _____

Age _____ Occupation _____ Department _____ Married—Single Widow—Widower

To what extent do you use—Tobacco? _____ Liquor? _____ Beer? _____ Have you been Vaccinated? _____

Is your Life Insured? _____ Ever been declined For Insurance? _____ What serious illness—Disease or Injury—have you ever had? _____

Previous service with this Company _____

Witness. _____ Signature of Applicant. _____

PHYSICIAN'S REPORT

Height _____ Weight _____ Respirations _____ Pulse _____ Eyes _____ Nervous System: _____ Vascular System:—Heart _____ Blood Pressure _____

Respiratory System: _____ Nose _____ Throat _____ Ears _____

Digestive System: _____

Urine.—Specific Gravity _____ Reaction _____ Color _____ Albumen _____ Sugar _____ Microscopic Sediment _____

Heredity _____

Remarks: _____

Date _____ 191__ I _____ of _____ employment.

Physician.

Form No. 798—2M—1913.

Fig. 1.

necessity in the building up of a permanent operating force, since we must maintain this force in the highest possible standing, and one man physically unfit means a handicap in this development.

Methods of Education Used in Various Companies.

After the applicant has passed the necessary qualifications

for employment and is accepted, we must immediately begin his education. I am assuming that the new men will be started at the bottom, this being the only way to assure harmony in the organization. There is nothing more prone to disrupt an organization than the promiscuous jumping about of men, who are advanced without regard to ability or length of service.

The most valuable men to an organization are those who have grown up in its service, who have started as youths of 18 or thereabouts, and who have reached the top by steady strides. These men are permeated with the spirit of the company and are the main stand-bys in cases of emergency or stress of any kind, in addition to having an intimate knowledge of the methods employed in this particular organization. Therefore, the younger we take our men, that is, young men having the ordinary conception of discretion, and begin to train them, the better off we will be.

Under a previous head, mention was made that while experience is without question the best teacher, yet we cannot afford to lose prestige through the mistakes of our men. They must be taught to avoid these mistakes, but the teaching must not interfere with the work of the corporation. Because of this, and also on the score of economy, the educational work in a large organization can, with advantage, be conducted in a place set apart from the actual work of the department.

In this more or less theoretical education there are two avenues of procedure to be considered: first, entirely by lectures, reinforced with demonstrations, embracing all phases of the work, and second, by specific schools of instruction wherever possible. It is to be understood, however, that all methods used for educating the men must be further assisted by their gradual development while on the actual work of the division. They must be put under trained men as helpers, and when they qualify as fitters, they must be closely watched by inspectors or foremen in order to help them over the rough places.

The size of the company is the fundamental determination as to whether the definite school of instruction is possible, but wherever there are any number of men doing the same class of work, there the individual school of instruction offers the greatest chance of success, since it instructs men without interfering with shop routine. Lecture courses are ideal for instruction in work which does not require mechanical skill, but where mechanical skill is necessary, the school of instruction is the place to acquire it, because there the men have the chance to actually do the work under a competent instructor.

Education by Lecture Courses.

In smaller companies the lecture course, reinforced by concrete examples and actual demonstration where possible, provides the best method for this work, although I do not think that the lecture idea can develop the thoroughness of mechanical training which is gained by the school of instruction. However, any means of instruction is an advantage, and if it be impossible to carry out the school idea, then the lecture idea should be put into operation.

I am going to quote briefly the procedure followed by the Pacific Gas and Electric Company as being an example of this lecture demonstration idea.

"This condition (the creating of all around men) has been arrived at by a night school to which all employes are eligible, they joining of their own volition, but having once joined, they must attend regularly and take every examination.

"The work is taken up several nights each month when a certain portion of the work is covered by lectures, explanations and practical demonstrations of the work covered by the lecture. After several lectures and demonstrations covering a particular portion of the work, the men are then given questions to answer. Should the percentage of the answers sent in be very high, we pass on to the next work, but should the percentage be low, we cover the same ground again.

"It is really surprising how beneficial these practical demonstrations have been. Frequently a subject is given to all of

the men, with a request that they send in a written answer, although it is not obligatory on the part of any one to do so. For instance, the following subject was given to the Gas Distribution Department, 'How would you handle a complaint from its inception to its completion?' Nearly all responded, the answers being carefully compiled, and such of those who did very well were commended, while those who did not do so well were brought together and the subject thoroughly discussed."

In Des Moines, where the company is even smaller than that in San Francisco, there is a definite educational scheme, which will be cited to serve as a possible example to those of like situation, a situation where a few men may eventually do all classes of work:

"We have an educational class which meets monthly and in which all of the men take an active part. The particular object of this class is to make the employes in all departments as familiar as possible with the work in all other departments, and incidentally specifically to instruct the group, the work of whose department is being developed at the meeting. In addition, each group in the shop force has weekly meetings under the guidance of their shop foreman, in which specific instructions and suggestions are given and the men are encouraged to take part in the discussions."

In the two instances cited, we have the lecture or lecture demonstration idea clearly set forth, and that these accomplish great good goes without saying. In these companies the size of the organization not only does not permit, but neither does it warrant, the expense of a school of instruction. The one possible objection to this method of procedure, when it is held outside of working hours, lies in the detaining of the men without pay, even though it be voluntary on their part. However, this may, after all, be more an imaginary evil than an actual one.

In some large companies, employees' meetings are regularly held for the instruction of the men. As an example the Dis-

tribution Department of the Philadelphia Gas Works requires their men to attend meetings according to a pre-arranged schedule. In the fitting department the meeting is usually held every Monday morning before the men leave the shop, and lasts for about an hour, but an occasional meeting is held at night for not less than two hours, starting about 7.30 o'clock. Meetings for the main and service men are always held at night, they being allowed a bonus for attending, as are all the men in the fitting department when they meet at night.

The subjects discussed at these meetings include the explanation of new rules and new features connected with the work, the discussion of errors made since the previous meeting, study of the rule books, etc. When a new appliance is placed on sale, specialists from the Appliance Division attend the meetings of the fitters for the purpose of explaining their construction, installation and adjustment.

Education by Means of Definite Schools of Instruction.

In the consideration of the establishment of a school of instruction, at the outset it must be clearly understood that the success or failure of the enterprise largely rests upon the appointing of the man who is to be the operating head of the undertaking. This man must be of the highest type and should preferably be one who has risen from the ranks through conscientious and faithful service. He should have executive ability, and also have the talent for teaching others and must be vested with absolute control of the school. Only by having such a man and giving him this authority will the school be successful.

He should report directly to the head of the department, not to some assistant or under superintendent, since the proposition requires careful watching to prevent discord between the shops and the school, and to insure the full benefit of the school being obtained by the distribution organization.

The New York School of Instruction.

In several of the larger companies, the idea of the school of instruction has been greatly developed, that of the Consolidated Gas Company of New York being probably the most complete example of its kind in existence. This school is entirely devoted to the fitting branch of the organization, and occupies the entire floor of one of the shop buildings.

By the New York method, the applicants for employment as helpers, are first "sized up" and if they are satisfactory, are sent to a district shop, where they work for several weeks in order that the superintendent may more completely judge them regarding their characteristics. While in the shop, they are put on all classes of work, and are also sent out in the district to act as helpers. If these young men are of sufficient intelligence, and show aptitude for the work, they are eligible for the first or elementary course given at the school, their names being placed at the bottom of a list of those waiting to go to the school. The system of instruction is graduated from elementary work, to the more complicated, which calls for thorough mechanical training.

An instructor, with numerous assistants, all expert in the business, handles from 30 to 50 pupils daily, keeping a record of their progress and reporting each day to the main office, from where, in turn, this information is sent to the different shops concerning their own men. In every study, the students actually perform the mechanical work which is called for. The day is divided into two sessions, morning and afternoon, different subjects being taken up at each, the classes being made up of those whose turn it is to attend the session.

When a new man first goes to the school, he is taught indexing, and is given a rating in this subject, and returns to the school until he attains proficiency in this branch, when he receives the O. K. of the instructor. The instructor will not pass a man in any subject unless he is satisfied that he is competent to perform the work in the district, and before being completely passed and given a second O. K. in a later

visit to the school, he must correctly answer 10 written questions pertaining to the particular subject he is being taught.

As soon as a shop is notified that a man has received an O. K. in a certain class of work in the school, he is allotted

Fig. 2

similar work in the district, but is accompanied by a district foreman, who reports upon his competency under conditions as met with in the district.

After the man has worked in the district until he is proficient in the work, and when the men before him have all

qualified for a higher grade of work, he is again sent to the school to qualify in the higher grade. In this way, men having a knowledge of the work, are always available.

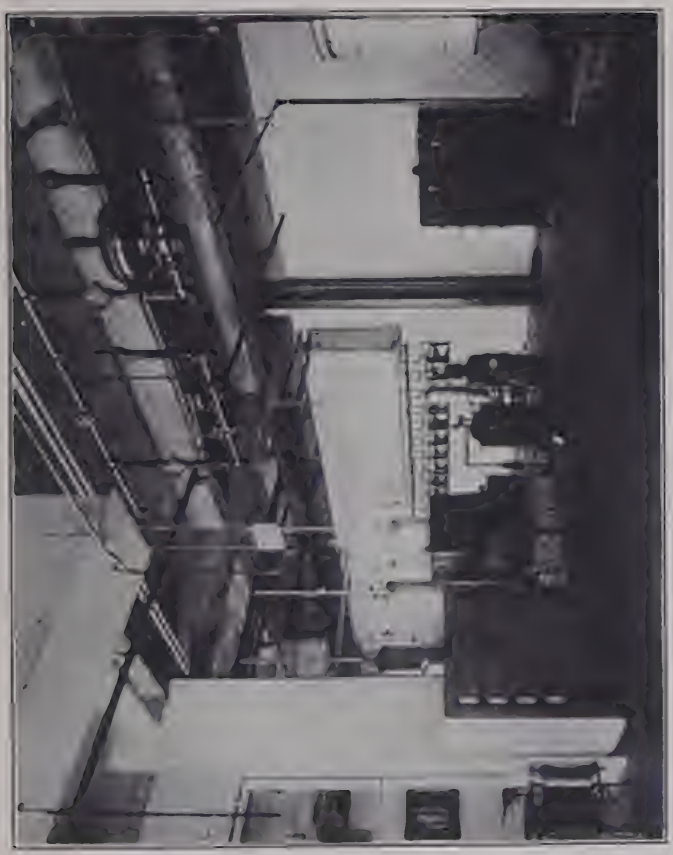


Fig. 1.

Some of the subjects upon which instructions and demonstrations are given in the school are as follows:

Locks and Unlocks.
Complaints.
Indexing.
Burners.
High Bills.
Leaks.
Stove Measurements.
Stove Sets.
Meter Measurements.
Meter Sets.
Stove Repairing.
Industrial Appliances.

Actual work tickets are used in dealing with these subjects.

In addition to this work, the men are taught to write their reports briefly and intelligently, and are also tested for their sense of smell, a defect in this being sufficient to bar a man.

Fig. 4.

The expense of the school is large when it is remembered that employes are paid wages in full, together with traveling expenses to and from school, but the results obtained in efficiency and loyalty have more than justified this outlay.

Fig. 2 is a general view of the school, showing the instruc-

tors' desks and the tables to be used by the men in writing examinations, making out reports, etc.

Fig. 3 shows the bake oven, steam boilers, etc.

Fig. 4 shows the demonstration meters, gauges, glass traps, glass fixtures, etc.

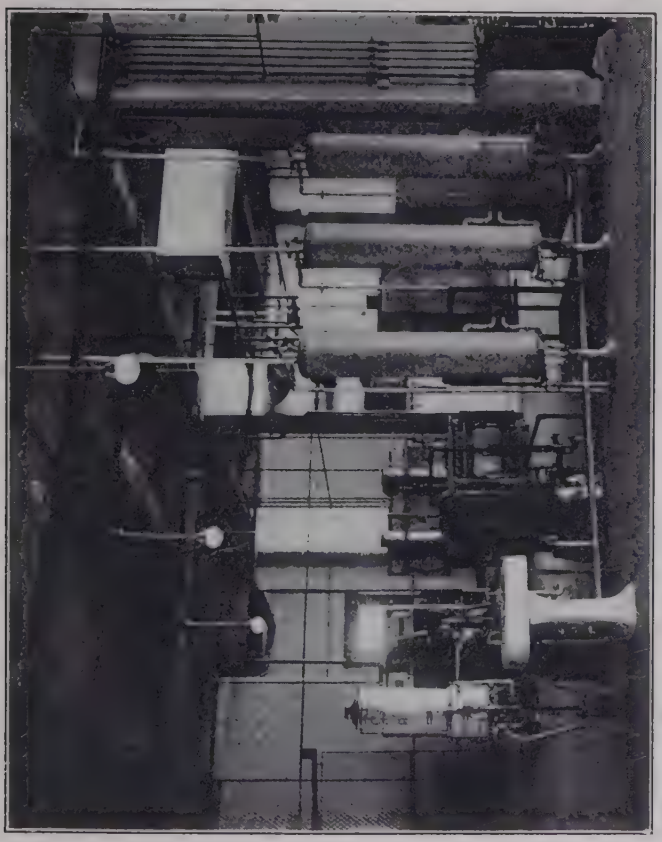


Fig. 5.

Fig. 5 is a sectional view showing boilers, and basins to which instantaneous heaters are connected.

Fig. 6 is a sectional view showing burner department and part of one section of cellar meters.

Fig. 7 shows a complete installation of cellar meters used for instruction purposes.

Fig. 8 is a sectional view showing the industrials, gas engine, anti-fluctuator, etc.

Fig. 6.

Fig. 9 is the daily report of the men attending the school and is sent to the office of the general superintendent.

Fig. 10 is the form filled out in the office of the general superintendent from the form shown in Fig. 9, and is sent to the shop sending the student to the school.

Fig. 11 is a card record of each student and is kept in the school for the guidance of the instructor.

Fig. 12 is the form used by the shop, and upon it is noted by the district foreman or instructor, his report upon the student's progress in the district.

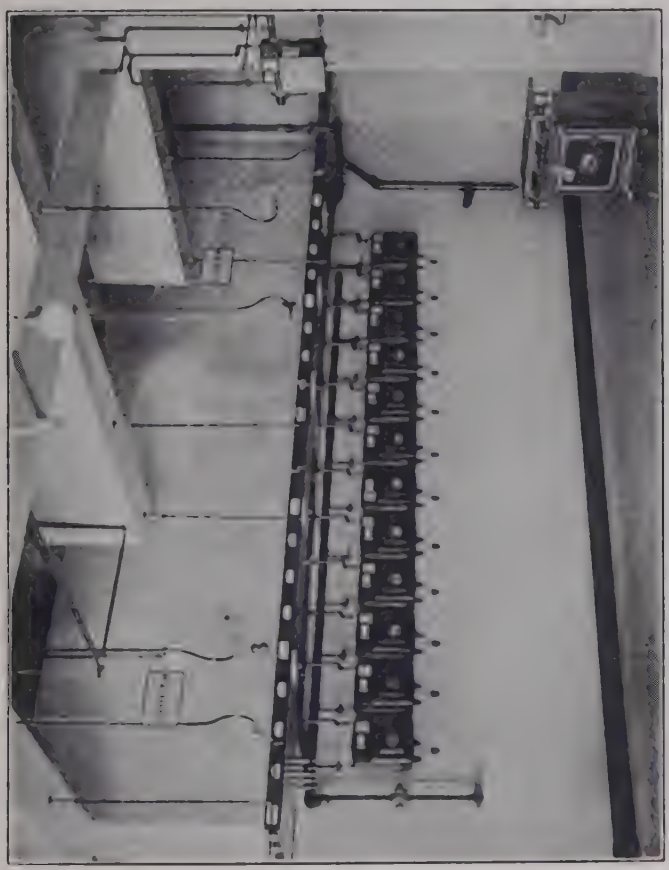


Fig. 1

Fig. 13 is the form used by the shop office and also by the office of the general superintendent to tabulate the instruction given the student in the school and also instructions

given him in the district. (Reverse side is used for district and is the same as the face.)

Fig. 14 is the form used by the student in answering

Fig. 8.

the questions before being given the second O. K. Three of the 10 questions refer to the general rules of the company, the remainder referring to the class of work he is being passed in.

2 B. Form 864-12-11-12

CONSOLIDATED GAS CO. OF N. Y. No 6000

School of Instruction Daily Report ..... 191___

NAME	SHOP	CLASS OF WORK	GRADING	REMARKS
				Instructor.

Fig. 9.

1M P. Form 864. 7-13

CONSOLIDATED GAS CO. OF N. Y.

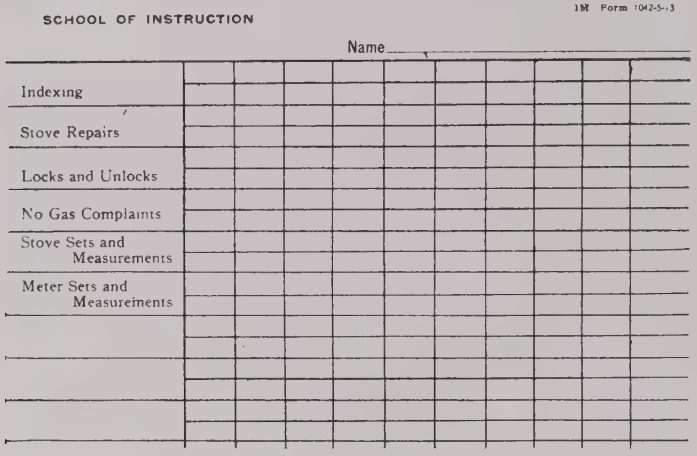
School of Instruction Daily Report APR 24 1914 19___

NAME	SHOP	CLASS OF WORK	GRADING	DISQUALIFIED ON ACCT. OF
				Instructor.

Fig. 10.

The Chicago Fitters' School.

The Fitters' School of the Peoples Gas Light & Coke Com-

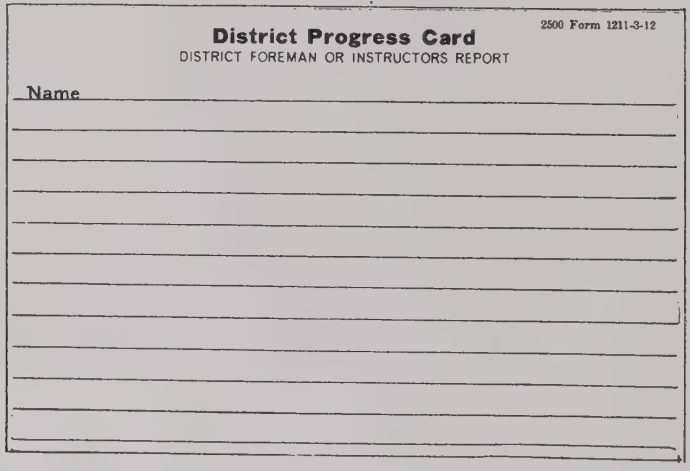

SCHOOL OF INSTRUCTION

1M Form 1042-5-13

Name

Indexing										
Stove Repairs										
Locks and Unlocks										
No Gas Complaints										
Stove Sets and Measurements										
Meter Sets and Measurements										

Fig. 11.


2500 Form 1211-3-12

District Progress Card

DISTRICT FOREMAN OR INSTRUCTORS REPORT

Name

Fig. 12.

pany occupies a building devoted entirely to this work. In this building are reproduced all classes of complaint causes;

here are all styles of ranges and water heaters for connecting

No. 1 Poor
" 2 Fair
" 3 No Use

Progress Card
SCHOOL

No. 4 Good
" 5 O. K.
" 6 Sense of Smell

Date Employed .....
Name ..... Rate .....

Book Index	Grading							
	Date							
Locks & U	Grading							
	Date							
Why	Grading							
	Date							
Com-plaints	Grading							
	Date							
Leaks	Grading							
	Date							
Burners	Grading							
	Date							
High Bills	Grading							
	Date							
Stove Meas	Grading							
	Date							
Stove Sets	Grading							
	Date							
Meter Meas	Grading							
	Date							
Meter Sets	Grading							
	Date							
W. H. Meas	Grading							
	Date							
W. H Sets	Grading							
	Date							
Stove Rep	Grading							
	Date							

2M Form 1058 11-10

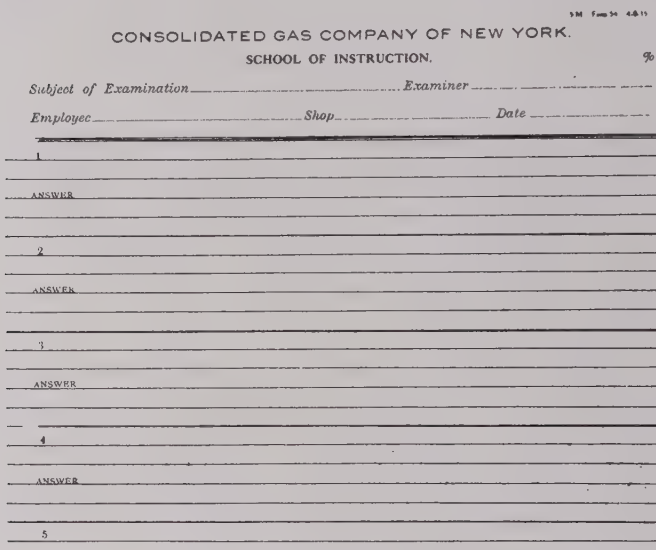
Fig. 13.

and adjustment; lamps of all kinds for hanging and main-

tenance; automatic water heaters, hotel and restaurant appliances, meters of all sizes, etc.

There is always one instructor at the school who is an experienced gas man, and he carefully watches each individual student. For special courses, special instructors are obtained.

The method of conducting the school, is, in brief, as follows:



CONSOLIDATED GAS COMPANY OF NEW YORK.

SCHOOL OF INSTRUCTION.

%

Subject of Examination ..... *Examiner* .....

Employee ..... *Shop* ..... *Date* .....

1

ANSWER

2

ANSWER

3

ANSWER

4

ANSWER

5

Fig. 14.

A man makes an application for a position with the company as a fitter or as a helper. If for a fitter, and if his general appearance is favorable, he is first sent to the school, and is given some actual mechanical work to do. He may be given a water heater or a range to connect, running the necessary fuel line and setting the meter. He may be given one appliance to connect and several to adjust, and some difficult jobs for which it is necessary to cut pipe. He is also given certain educational tests to determine his ability in reading, writing and his knowledge of simple mathematical problems. The primary object is the determination of his mechanical ability and his general characteristics.

If the man applies for the position of a fitter's helper, he is given the same series of questions to answer, and various other tasks of a very simple nature are performed by him, the main idea being to determine his willingness to work at any

Fig. 15.

given task, as well as his dexterity along mechanical lines. These and all other men who attend the school for any reason, have their sense of smell tested, the necessity being obvious, since a developed sense of smell is necessary for a man handling gas.

By means of these various examinations of applicants, many undesirables are prevented from obtaining positions with the company, and causing trouble later which would result in their discharge. Not only is the company thus protected, but also

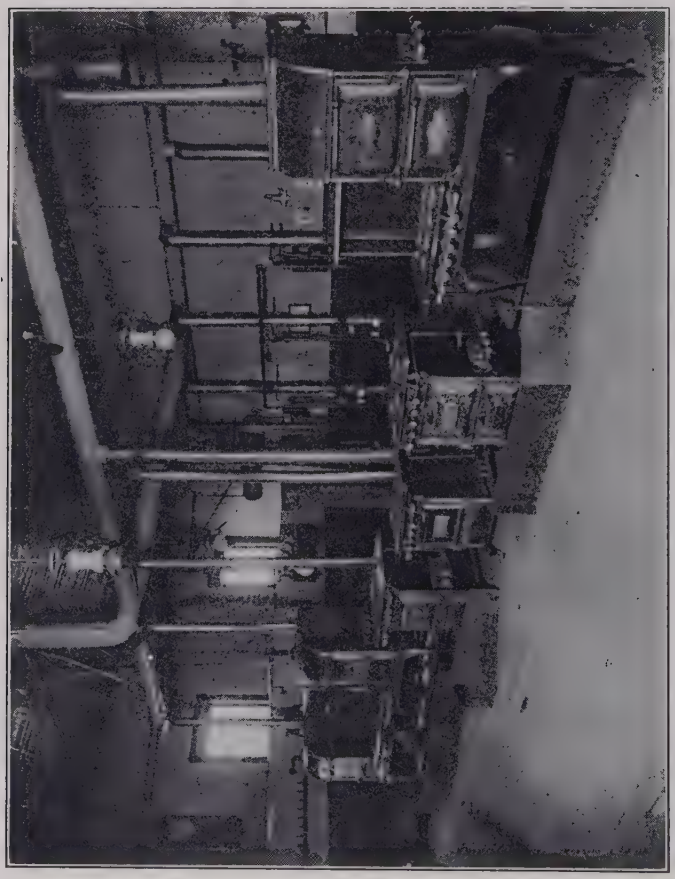


Fig. 16.

the customer is protected, and incidentally the man himself is protected.

In conducting the courses of instruction, an effort is made to prepare the men for the seasonable work of the company.

By this is meant courses which closely precede the special work which each season of the year brings forth. In the early spring, all of the fitters and helpers are instructed on appliance installing; for some, it is a review, while for some others,

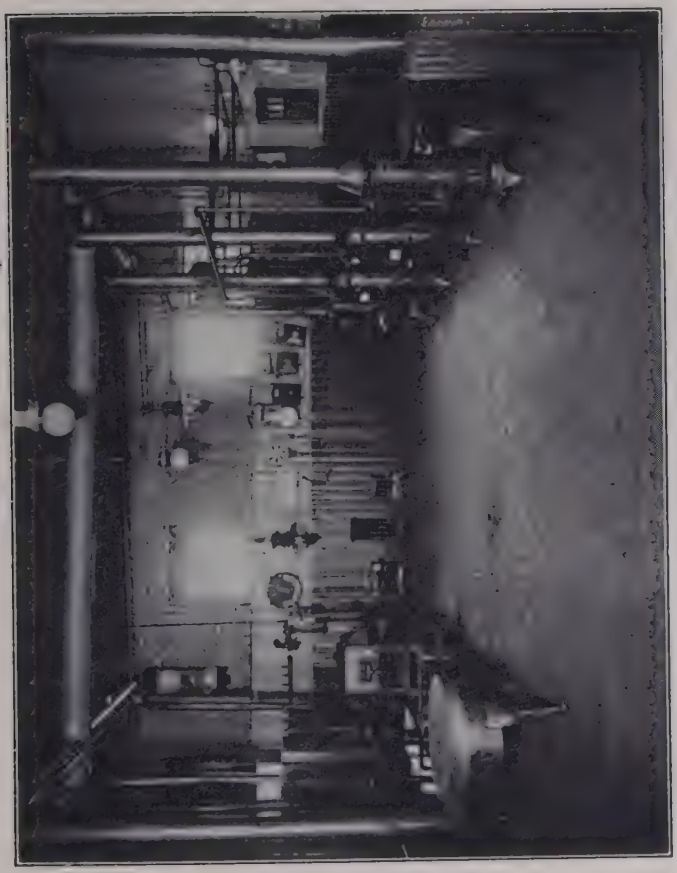


Fig. 17.

it is, in some phases, new ground. These men actually connect up appliances--Fig. 15 showing the arrangement of basement and kitchen conditions. They run the fuel line and set meters, making out the necessary tickets. They are

drilled on rules, and are given pertinent instruction regarding their conduct on a customer's premises.

In the early fall, similar classes are conducted in lamp work, and in the later fall, classes are conducted in complaint work.

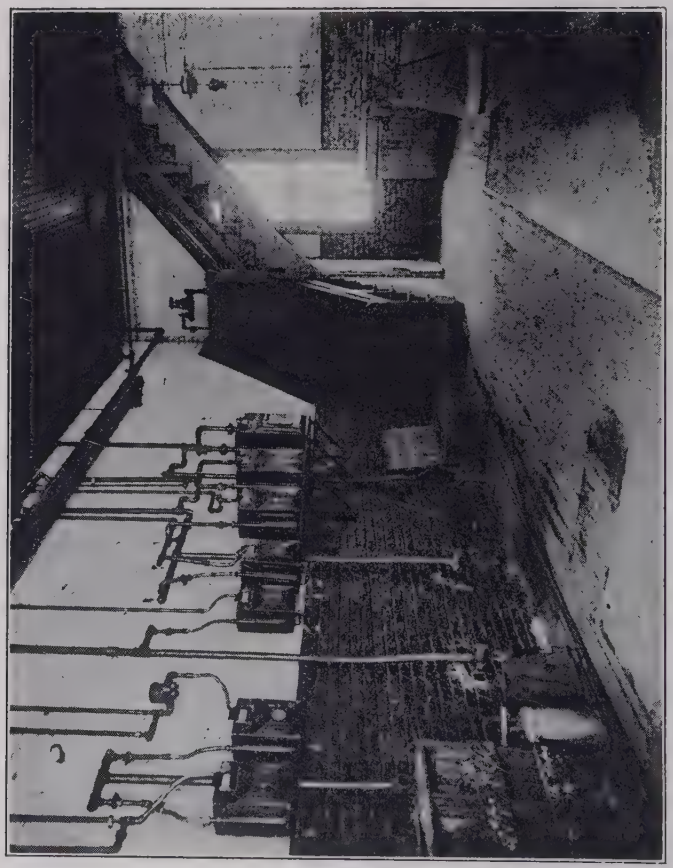


Fig. 18.

All men, whether fitters or street men, who are expected to act as complaint men, are drilled at the school. By means of trapped services and risers, leaks, poor supply, binding meters, etc., these men are instructed and reviewed in this particular branch.

At other times classes in stove adjusting are conducted—Figs. 16 and 17 showing some of the appliances used in this work. Helpers are trained for fitters, and fitters are reviewed in their weak points. Fig. 18 shows a few

Fig. 19.

of the various meters used in the course of meter setting. Fig. 19 shows the appliances used for the course in the adjustment of hotel and restaurant appliances. In Fig. 20 is shown the exhibit of trapped services. This is made of nickel-

plated piping and glass tubing, and visibly shows these troublesome conditions.

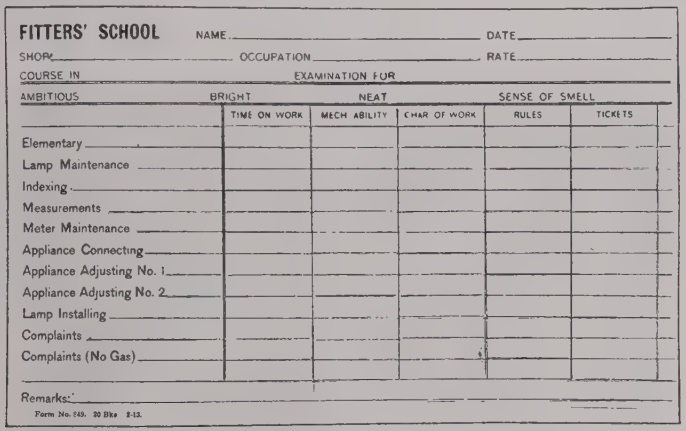
In Fig. 17 is shown several of the lamps used for hanging

Fig. 20.

and adjustment. The large index used in the teaching of indexing is also clearly seen in this picture.

Fig. 21 is a form of report card sent through on every man who attends the school. This specific information is of

value to the division superintendent, providing for him a helpful means of sizing up his men.



FITTERS' SCHOOL NAME _____ DATE _____

SHOP _____ OCCUPATION _____ RATE _____

COURSE IN _____ EXAMINATION FOR _____

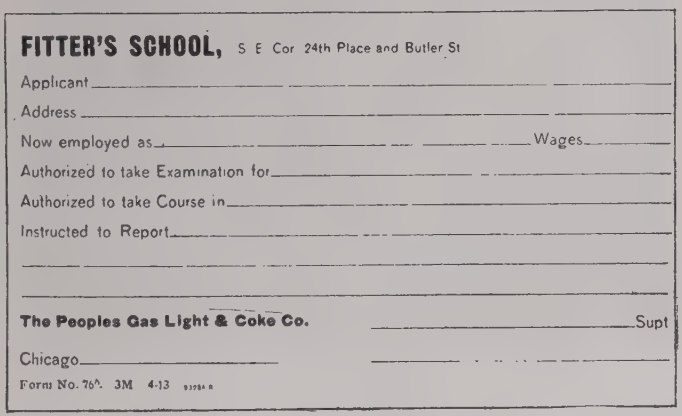
AMBITIOUS	BRIGHT	NEAT		SENSE OF SMELL	
	TIME ON WORK	MECH ABILITY	CHAR OF WORK	RULES	TICKETS
Elementary					
Lamp Maintenance					
Indexing					
Measurements					
Meter Maintenance					
Appliance Connecting					
Appliance Adjusting No. 1					
Appliance Adjusting No. 2					
Lamp Installing					
Complaints					
Complaints (No Gas)					

Remarks: _____

Form No. 749. 20 Blks 2-13.

Fig. 21.

Fig. 22 is the form of identification ticket which is used when sending a man to the school. It also serves the purpose of telling what course or examination he is to take.



FITTER'S SCHOOL, S E Cor 24th Place and Butler St

Applicant _____

Address _____

Now employed as _____ Wages _____

Authorized to take Examination for _____

Authorized to take Course in _____

Instructed to Report _____

The Peoples Gas Light & Coke Co. _____ Supt

Chicago _____

Form No. 76⁵. 3M 4-13

Fig. 22.

Another phase of the adaptability of the school lies in the testing of all men who are to be raised in rate or in position.

These tests are along certain prescribed lines, and no matter how much the man knows beyond the requirements of the grade to which he aspires, he is required to be familiar with all up to that grade. If a man fails to qualify or is weak in

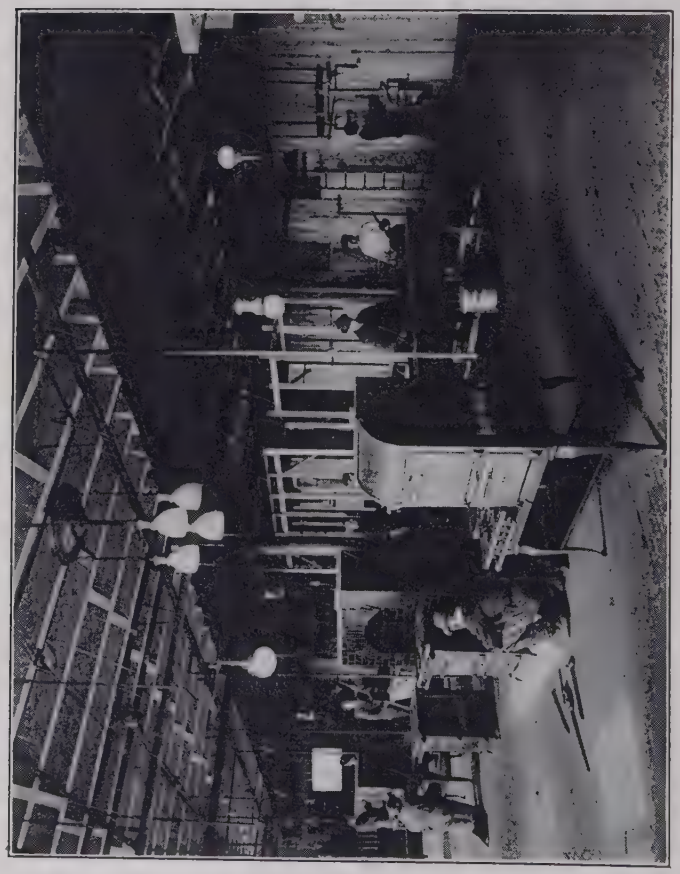


Fig. 23.

some particular item, a report is sent to the shop and if the ideas of the shop and of the school do not agree, the matter is discussed between the superintendents of the division and of the school, and a decision reached.

Many conditions of service are faithfully reproduced at the school, and whenever a new cause of complaint is found on the division, attention is called to it at the school, and if possible the condition is reproduced.

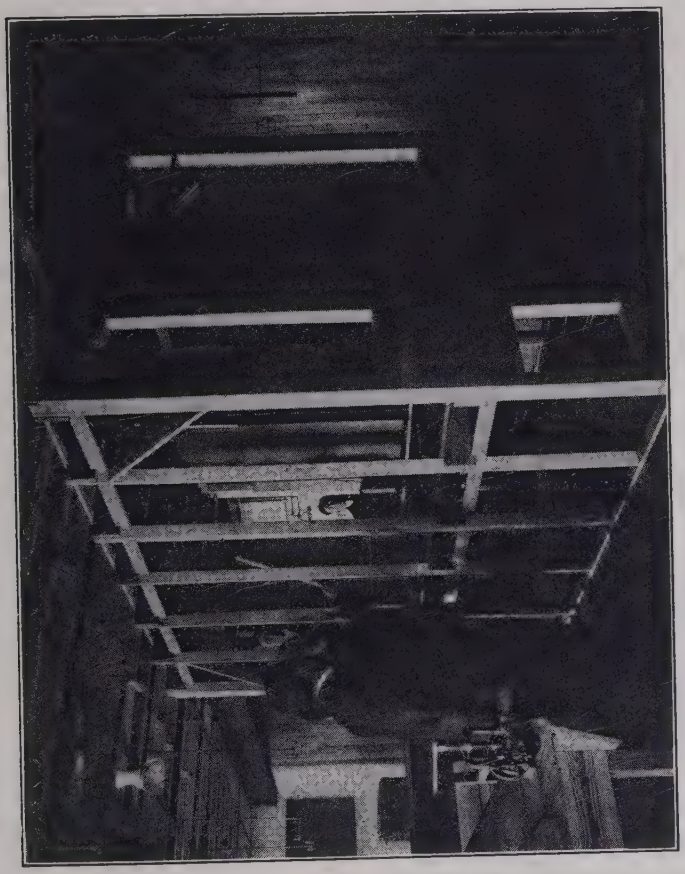


Fig. 24.

In the three and one-half years of operation, the total attendance, up to January 1, 1914, was 2,408 men, 1,288 of these being there for the first time. The men stay at the school for varying lengths of time, depending upon their effi-

ciency when they were sent for instruction, but only one day is spent in the testing of a man. When the examination is that of an outsider applying for a position, the day is spent on his own time, all of the company's men being carried on the school roll.

The method of operation is, therefore, different from that of New York, caused by the difference in the organization of the street department, and the difference in the manner of conducting the work. The result is the same, however, the end being the increasing of the efficiency of the daily work of the men, by teaching them the requirements of the individual gas company.

The Training School of the Baltimore Gas Company.

The Consolidated Gas, Electric Light and Power Company of Baltimore has recently established a training school in order to provide facilities for the instruction of its distribution men. The school is located on the third floor of the main distribution building, and covers a floor area of about 3,700 sq. ft. A man of vast practical experience has been placed in charge of this work, so that the results obtained will be of the highest quality. I shall briefly quote from *The Baltimore Gas and Electric News* as to the operation of the school:

"At the present time a course of instruction for fitters is in operation and is intended for all employees who are engaged in fitting work, regardless of position, department or length of service, and, with a view to co-ordination of operations, the full course is prescribed.

"Employes now in the service are taken from the various departments at scheduled periods, in numbers which do not seriously interfere with the operations in those departments.

"When new men are employed, they are at once enrolled in the company's training school.

"The period of time covered by the course depends upon the progress made by the individual. A man who does not fulfil the requirements established by the school is not retained in the employ of the company.

"All periods of instruction are held during the daytime, the company paying the employe's salary while engaged in the school work.

"Field work, or work done in actual practice under the

Fig. 25.

direction of a street instructor, is a part of the school training.

"The school plan provides for occasional meetings of department heads and foremen, for the purpose of standardizing the company's policies as applied to fitting work.

"Close study of the company's book of rules is required."

Fig. 23 presents a general view of the school of instruction. Fig. 24 shows a skeleton model of a house providing a

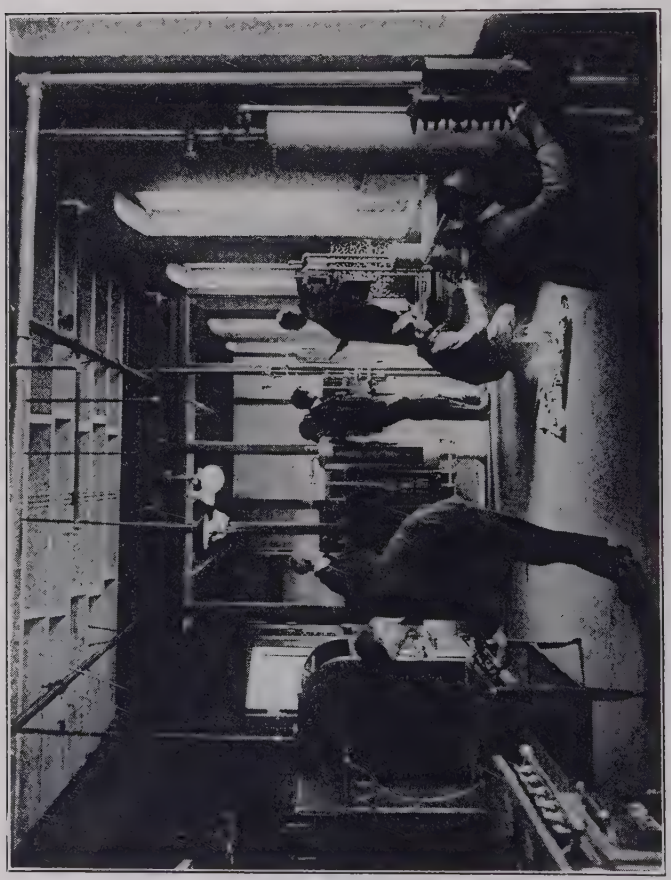


Fig. 26.

means for demonstrating the proper method to be pursued when installing house piping.

Fig. 25 shows how workmen are taught to read meters. The index shown is on one of the four sides of a contrivance

which revolves around the post, each side bearing a different type of index. The hands of the dials are movable.

Fig. 26 shows workmen repairing and adjusting various types of gas appliances.

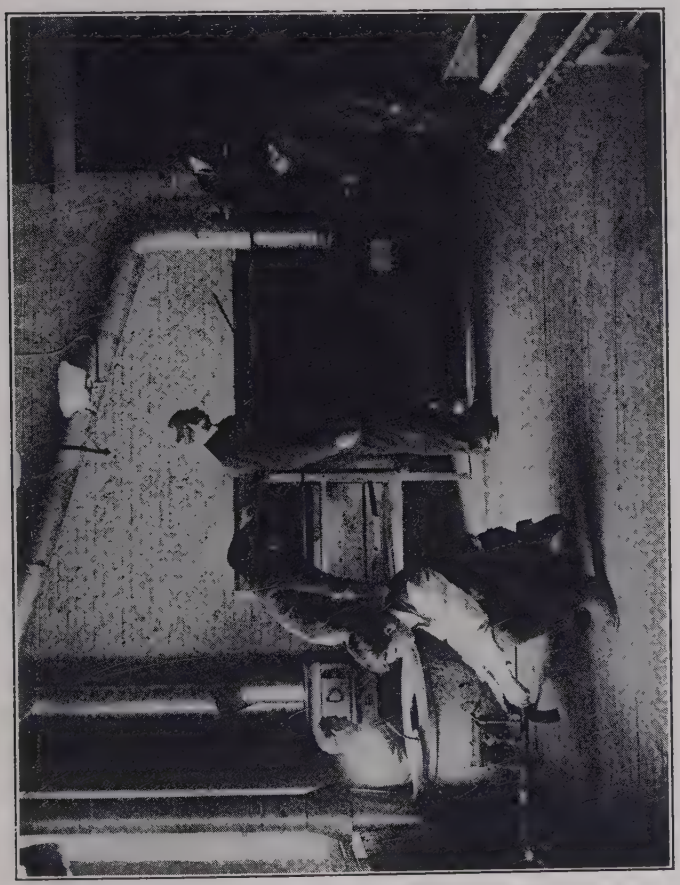


Fig. 27.

Fig. 27 shows workmen adjusting hotel and restaurant appliances.

Fig. 28 presents a view of the models which demonstrate various conditions of defective piping. The models are

of glass construction and the arrangement permits of many striking examples of defective installations, demonstrating in a graphic manner the trouble encountered in actual practice.

Fig. 28.

Fig. 29 shows the instructor explaining methods of sketching house piping plans.

Fig. 30 illustrates a lesson in the proper way of installing meters.

Fig. 31 shows a lesson in lamp and fixture work.

Fig. 32 is the form used to cover the progress of the employee during his term in the school, and furnishes a reference as to his capabilities in various directions.

Fig. 33 is a form which shows the history of the

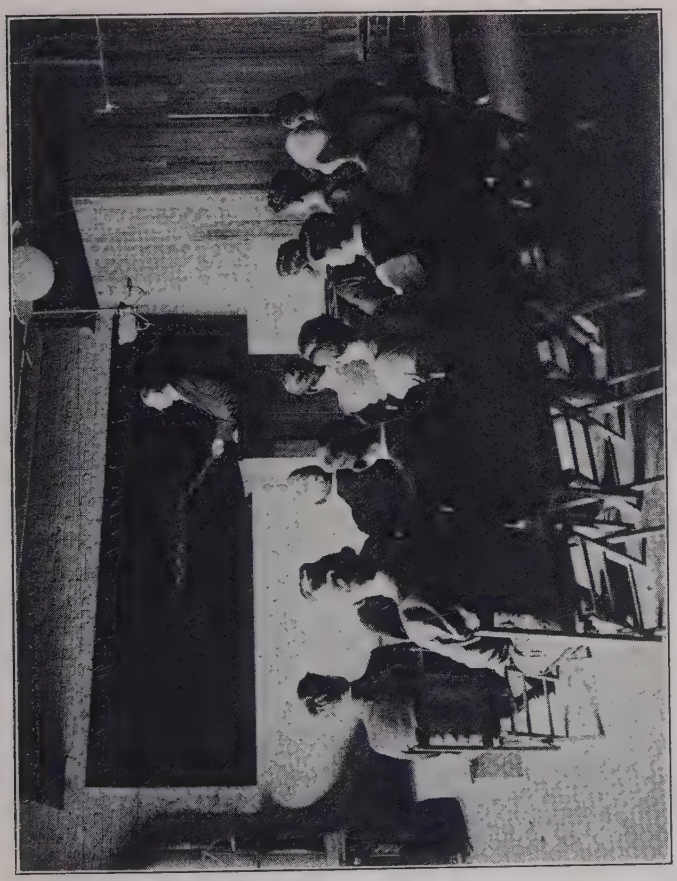


Fig. 29.

employee since his entrance into the company's employ. It is intended to aid the instructor in keeping close touch with the progress made by the employee before and after instruction in the school, and it is further intended to impose upon

the instructor some authority as to the changes made in the standing of the employe concerned.

Work in Scattered Towns.

Another point to be considered in the working out of any

Fig. 30.

educational scheme, is that incident to a company operating in a series of small towns. Here numerous problems confront the superintendent who desires to increase the knowledge of

his men. Usually the operating forces in these towns are limited to two or three men, and the towns themselves are usually separated by considerable distances. In this event, even were there the necessity to call meetings, the time and

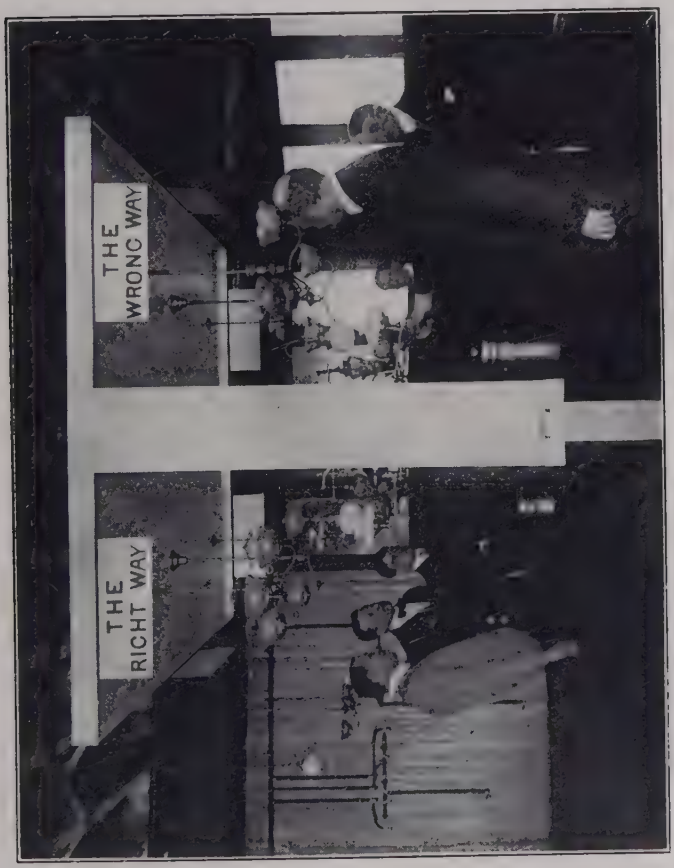


Fig. 31.

expense consumed in travel would be out of all proportion to the good accomplished.

It may be possible, however, to call together the fitters and helpers and other employes of the company, in sections com-

posed of towns in reasonably close touch, and to make these meetings partly for social and partly for business purposes.

Form P 106—500—1-2-14—Req. 18716

DAILY RECORD OF EMPLOYEE'S PROGRESS

SCHOOL OF INSTRUCTION — Consolidated Gas Electric Light and Power Co. of Baltimore

Name _____ Badge No. _____

General Appearance _____ Sense of Smell _____

DATE	TIME FROM	TIME TO	SUBJECT TAKEN UP	REMARKS

(OVER)

Fig. 32.

F 105—1M—3-2-14—Req. 18706

EMPLOYEES RECORD

SCHOOL OF INSTRUCTION — CONSOLIDATED GAS ELECTRIC LIGHT AND POWER CO OF BALTIMORE

NAME _____ AGE AT TIME OF EMPLOYMENT _____ MARRIED / SINGLE BADGE No. _____

Date of Employment _____ Position _____ Rating _____

Previous Employment Including Dates, Etc

DATE	INCREASE IN RATE	CHANGE IN OCCUPATION	ALL OTHER CHANGES REASONS AND REMARKS

OVER

Fig. 33.

Then the lecture idea offers the best solution to the problem, reinforced by bulletins issued from headquarters calling attention to certain phases of the work.

Comments on Preceding Headings.

It has been the endeavor in the subject matter under the preceding headings to briefly sketch the methods employed in six companies as being examples of the form of education. The question may be asked regarding the possible desertion of the men to other organizations, after they have learned the trade at the expense of the company which has furnished them with an education. I do not think that there is any more likelihood of this taking place, when the men have been trained in definite educational work, than where they have picked it up by practical application. There are no statistics, of which I know, to bear this out, but I do know that in Chicago it does not hold true that men flock to other organizations after receiving and education in the company's school, and I have been informed that the same is true of New York.

Naturally men leave an organization, but they leave for a substantial reason. They may be discharged, they may be laid off during slack periods and fail to return, or they may leave through their own volition to accept better positions, or they might find work uncongenial, but a lack of a definite educational scheme does not prevent this. On the other hand, I believe that the more thoroughly a man is aided in becoming a "gas man" the more apt he is to remain with the company. There seems to be some agency, a factor, that has produced a general situation that is typified by the expression "Once a gas man, always a gas man."

This paper has not dealt very extensively with the street men as figuring in an educational scheme, since I do not possess information concerning the existence of any schools of instruction for street men. There is no reason, however, why the street man should not be taught the fundamentals of his work with the same ease as that with which the fitter can be taught his. This was clearly demonstrated in the Peoples Gas Light & Coke Company of Chicago, when extensive calking with lead wool was first introduced in that company. A course of instruction was immediately established to show the men

how to handle the pneumatic hammers, how to caulk joints, etc., and the scheme worked very successfully, *because it was absolutely necessary*. Likewise the same result obtained when the welding of mains was first introduced. The enlargement of the idea to include all of the mechanical work connected with the street operation is a short step, and this would be productive of as great economies as that produced by the school for fitters.

I recommend that serious consideration of this subject be given by the various companies, and should like to see this phase of the teaching of our distribution forces worked out with more detail.

Several of the companies which depend on the lecture demonstration idea have included their street men in their lectures, and this field is as important with the large companies that have schools of instruction as it is with the small companies which have none. In Chicago, as has been before noted, some of the street men of the better grade are trained in the handling of "no gas" complaints and are as capable in caring for this work as are the fitters.

Aids in the Creating and Maintaining of Efficiency by other than Strictly Educational Means.

In this section topics of a more or less philanthropic nature will be lightly touched upon, since by these aids the work begun by an educational scheme may be aided to a successful consummation.

Wages.

Undoubtedly the subject of wages is the one most important phase in any industrial scheme, and the one over which most of the labor discussions take place. It is not possible, within the confines of this paper, to discuss this feature, since in each community there will be certain required standards which must be met. However, the imperative need for a living wage, at the beginning of a man's employment, a wage that will enable him to live decently, is only just and proper,

and by providing this, we will lay the foundation of a contented force and a set of men who will stick with us.

Working Hours and Time Off.

The question of working hours and time off is another feature which will be largely guided by circumstances and environment. In the Consolidated Gas Company of New York, in the fitting department, mechanical men who have been in the service of the company for a period of four years, receive a week's vacation at full pay, while those who have been in the service for less than four years, but more than three years, receive three days' vacation with full pay. It is so arranged that one-half of the operating force is given each Saturday afternoon off with full pay during the summer months. In the Rochester Railway & Light Company, all legal holidays are given to the distribution employees, with the exception of laborers, at full time, and the foremen are given a week's paid vacation each year, although they are not paid for overtime.

Personally I feel that at the outside, a 9-hour day is of sufficient length for any one to work, save in cases of emergency, and I also feel that all foremen, etc., should receive a vacation period with pay, since these men are usually on a monthly basis and receive no compensation for overtime. This will, however, be dependent upon circumstances.

Welfare and Pensions.

By means of these items much can be accomplished in the creating of a permanent force, and for this reason a welfare and pension system is strongly advocated. The Peoples Gas Light & Coke Company, of Chicago, has a most complete welfare and pension system, and this has gone far in the building up of a permanent and loyal organization, especially among the older men. A staff of competent physicians is maintained, under the direction of a chief, who is a man of remarkable clarity of vision and who represents the highest type in the medical profession. These physicians examine

every applicant for permanent employment, attend the injured employees and visit and advise the sick in certain instances, in consultation with the family physician. Injured men of all classes are paid full time, and wage earners, or those who are paid by the day, who are ill, are paid full time for a period of 7 days, and half time for a period of 6 months. Salaried employes, off on account of illness, are paid full time for 6 months. At the expiration of this period, it is discretionary with the officers of the company what shall be done. Death benefits are also paid as follows: If the deceased has been in the service for a year and leaves dependents, a year's salary is given to these dependents. If there are no dependents, funeral expenses up to $100 are paid.

In the giving of pensions, certain requirements are in force, but it resolves itself into the following: "For each year of service, there shall be made to the employe placed upon the service annuity roll, an allowance amounting to 2 per cent. of the average monthly pay received by such employe during the 5 years immediately preceding retirement." All the expenses of these benefits, both welfare and pension, are borne by the company, the employees not contributing any sum for its support.

In other companies the employes have mutual benefit societies, among which might be mentioned that of the employes of the Consolidated Gas Company of New York and that of the Rochester Railway & Light Company. I am sure that the information regarding these systems will be gladly furnished to any interested persons.

Social Meetings.

Much good will result from organizations among employes devoted to social purposes, since it awakens a spirit of unity and co-operation among members of the various departments of the company. Such an organization often goes far in removing differences existing between departments which have arisen mostly through a lack of information on the part of the various operators in the different departments. There

are many examples of work of this nature at present prevalent in the gas industry.

Another potent factor towards co-operation between the various departments is found in the publication of an employees' magazine, embracing all departments. If such an undertaking is properly managed, it will give the distribution man a clear insight into the workings of the other departments and, when used in conjunction with social gatherings, is extremely valuable in cementing the organization into a homogeneous whole.

Conclusion.

In this paper it has been the endeavor to condense into a short treatment of a most important subject, that which might well fill volumes. By means of the arguments of men of standing and experience, and by facts, I have tried to show the need of educating our men to be of the greatest service to us and to themselves. A treatment of the educational schemes of several companies has been dealt with, and to those who would go this path, the way has been pointed out. That it is impossible to lay down any sets of rules for the conduct of educational work must be recognized, since the conditions in various communities are so vastly different.

The establishment of educational facilities, the providing of some plan to recognize good and faithful service and the elimination of the petty troubles which prevent the men from putting their whole being into the work are strongly urged. We must remember that we are building for the future, and that if we do not do our part in helping our operators to better themselves, they are not going to help us to properly conduct our business.

As one man in the gas industry remarked when approached on this subject—"If I were to give any single statement concerning the improvement of distribution employees, I should say that the practice of the Golden Rule will produce the results." This is strong logic although it may have a Utopian sound, but since the very life of our industry rests upon the

service we obtain from our men, it behooves us to provide at least the tools and attributes to aid them in properly conducting this work.

Dr. Galloway, in his Atlanta paper says: "If the gas companies want their representatives to stand for the big idea of public service, they must instruct their employes so that they may gauge that idea. The company must see to it that the community is not better informed than are its representatives. It is quite possible that a company's advertising may be more conspicuously displayed before the public than before its employes. It is, therefore, also possible that the consumers may read and believe, the public be pleased signs of public service corporations while the employes of the company may remain in ignorance of either the sign or the methods necessary to carry out the policy."

This expresses the necessity in a way that makes the company the absolute power to provide its employes with the idea of service, and, therefore, it devolves upon every distribution man to "read, mark, learn and inwardly digest" these expressions of the men quoted in this paper so that they may realize that the production of this cohesive operating force is well worth the time and consideration of the best men in their organizations. In concluding, the writer wishes to acknowledge his indebtedness to all those who by their advice and assistance have made this paper possible.

(Mr. Reinicker read an abstract of his paper.)

The Acting Chairman: You have heard this interesting paper, and here again it is a great pity it had to be abstracted. I think if you will take it to heart you will find it is a classic. I think it is one of the most important things that has been put over in our Institute. The paper is now open for discussion.

Mr. G. R. Althen (Baltimore): This paper should aid materially in stimulating the interest in this all-important theme. The encouragement which is being given the subject

by many of the larger industries in this country can be considered as one of the most gratifying indications of our national industrial progress, and the impetus thus far bestowed bids fair to engender a wide-spread interest in industrial training work.

The gas industry in particular furnishes a most promising field for endeavor, and the fruitful results obtained thus far by those companies which have in force a systematic plan of training their employees, should furnish sufficient inspiration for emulation.

In the distribution department, the need for careful training is notably apparent, in that in many of its branches, a high grade of skill is required, and furthermore, the employee must efficiently serve the needs of an exacting public.

A plan of education to be effective must be conducted along impressive lines. With the average workman, an impression can best be made on the mind by practical demonstration, and this principle is basically the plan of the school of training which has recently been established in the Baltimore company. Before the plan was adopted in this company, instruction had been given through a course of lectures, delivered by men qualified along definite lines of work. Although the lecture plan proved, in the main, successful, it was a matter of conjecture whether the result obtained fully justified the effort expended. The school of training has proven, without question, its great value as an educational medium and the student employee need no longer picture a condition in his mind, but is enabled to see it in practical application, and this carries with it a lasting impression.

In the Baltimore school, which to some extent Mr. Reinicker has described, careful attention is given the new employee. He cannot, for example, enroll with the company as a fitter until he has passed satisfactorily through every phase of the training work, both in the school and in the field, and has qualified for that capacity. The danger, therefore, of employing "costly experiments" has been practically eliminated, as the

instructor is enabled to gauge the fiber of the new recruit, so that "seed may not fall upon barren soil."

One advantage of our school of training, which has been particularly emphasized, lies in the facility with which operations of our workmen may be co-ordinated, for within a short time we have effected the consolidation of two large departments which had formerly specialized on a distinct class of distribution work. As a consequence, the man who formerly was only considered proficient in one line of work, is now proficient in two, and it is not difficult for us to estimate the value of this fact in its bearing on the customer, the company and the employee.

Another striking element in training school work, which can be appreciated by all practical gas men, is the fact that the workman is instructed to perform his duties along uniform and standard methods of operation; for example, one workman may execute his work in a certain definite manner, while another may pursue an entirely different method in accomplishing the same result. There is, as a rule, only one "right" way, which, after all, is a fundamental thought which should govern the purpose of industrial training.

Industrial training in the distribution department when conducted along systematic and practical lines, affords "A way to the right way," which leads directly to higher efficiency, economy and good service.

Mr. Reinicker does well in emphasizing the far reaching influence wielded by the individual workman in creating the public's good will toward the company. Too often do we find our most efficient workmen sadly deficient in cordiality toward the customer, simply because he has not acquired those two essential attributes to good service—self possession and tact.

Realizing the potent influence for good in impressing the men with the significance of their personal attitude toward the customer, the Baltimore school is endeavoring to make this feature one of the prime objects of its work. We are con-

tinually striving to encourage the good will of the public toward the company, and our short experience in systematic training school work has proven that it furnishes an effective means to that end.

I have noted where Mr. Reinicker refers to the average unskilled laborer as a "floater or parasite, without responsibility, and worthless to the community." Personally, I am inclined to think that the unskilled laborer is, in the main, industrious, trustworthy and law-abiding and serves as a necessity to the community.

I must also question the statement made that, "The satisfied class is in a great minority and as a result the state of modern industry is one of unrest." If this be true, I cannot help feeling that the burden of the responsibility rests rather on modern industry than on labor, and that such a condition must inevitably lead to disaster to business in general. Any unrest which might exist could, I believe, by close analysis, be localized, and I am quite certain would not be found existent to any marked degree in the gas industry in general.

Mr. C. C. Simpson (New York): Mr. Reinicker has prepared an admirable paper on a very important subject, though I think that he has slighted a very important section of the distribution department. Fortunately—or unfortunately—in New York we have a meter department and a main and service department. Mr. Reinicker confines his remarks to meters and jobbing. Our meter department has a school of instruction, which is described in the paper and needs no further mention. We also have a separate school for street department men. We established that school this year because we had to, having practically reached our limit in available men. There is no such a thing as a trade of gasmen. The old hands are dying off fast, and we had approached the point where we had a great amount of work to do without the men available to handle it. We cannot advertise for gasmen, because they are not to be found. This school which we have established is merely a miniature street department, under the

direction of a competent, practical instructor, who works along the course of instruction established by a school committee of superintendents. Up to date, this school has turned out about one hundred good, skilled gasmen, and of these one hundred men, but one has failed to make good. Ninety-nine per cent., I think is a pretty fair record. When we are not as busy as we are now, we will take these men and put them through the school again in a slightly higher grade. I cannot invite you up to our school for the reason that there is nothing particular to be seen; the men are merely doing ordinary street work under the supervision of a competent instructor. Before leaving the school, the men are examined by the school committee and must obtain a passing mark of over 75 per cent.

Mr. W. D. Kelly (New York): I do not feel that I can add anything to Mr. Reinicker's very excellent paper. It is probably the first serious effort to call attention to a department which is, in many ways, the most important in the company.

We have a school of instruction for gas company fitters in New York, and on behalf of the Consolidated Gas Company of New York, I extend a most hearty invitation to the gentlemen present to visit it on any day during or after the Convention.

Mr. D. E. Keppelmann (San Francisco): I made a few notes on Mr. Reinicker's paper, which is both very important and a very vital subject to all of us. We formerly had in San Francisco six departments covering all the work of distribution. Under this system a man might be a good meter man, and not know a thing about the service department or vice versa,—a good service man who could not set a meter. We united all the departments, with the result that all the men are becoming experienced in all departments of gas distribution. We have school two nights each month, with lectures covering all the work, and everybody must be there. In addition to the lectures, we have practical demonstrations. We even go so far as to call a man from the room and ask him to caulk or

weld. We have stereopticon slides covering, not only welding, as you saw to-day, but all the work from beginning to end. We go back a little further, for we believe that the condition of the man's mind is a large part of the problem. We ask him to bring his troubles to us; and we have helped him, for instance, in case where a man's wage has been attached, we go to the sheriff's office and bring about a release, which is possible because of the fact that the former manager of the gas contract department is now the Chief of Police. Before the recent labor troubles, we had seven hundred men, and they were one big happy family.

That is proven by the fact that a short time ago the employees were given the opportunity to purchase first preferred stock of the company, and with an unusually small department, 200 shares were sold, which speaks very well for the organization. I believe if we go a little further back, and look at the human side, and place the man's mind in the proper condition, we will get better results. I will take one specific case, the result of team work, to prove my contention. We took an average cost of 10,000 services picked at random, which formerly cost our company, including labor and material, painting, etc., an average of $30.40 per service. We later took the same condition for 10,000 services, and found the average cost cut to $19.00 per service. Besides helping the employee financially, we also go so far as to send him fruit and flowers in the event of sickness. When we learn of an employee cashing his pay checks in a saloon and spending most of it for drink, we immediately call him to the office and compel him to assign his wage to me personally, authorizing me to give the check to his wife, which insures his family. We give a dance occasionally, and Mr. H. Strange, of Honolulu, told me that his company did all of that, and more. He stated that when an addition was expected in the family of an employee, the gas company took care of the case from the beginning to the end.

Mr. W. H. Rogers (Paterson, N. J.): Mr. Keppelmann said he believed the improvement of distribution employees was

a matter of changing mind,—a matter of improving thought. I understood him to mean their conception of their duties. I would like to voice the thought that in these schools for improving the mechanical work of employees, there should also be included instructions not only for the way in which they should treat the public, but also the way in which they should think of the public. You know that you may have a president of a company, a general manager and a business manager, who have nothing but good will in their hearts toward the public, and may have the glad hand and pleasant manner, and may make sales and customers. But to many consumers, the only person who, in their minds, represents the company is the distribution man, and I think that he should be instructed in such a way that while trying to reduce the cost per order, which is all right, he should still bear in mind the duty which the company owes to the public, and endeavor to meet the public in a tactful and polite way. Not that this is not generally done, but it is important, I think, that the matter should be taken care of.

Mr. Walton Forstall (Philadelphia): Mr. Reinicker has brought before us a subject upon which there can be many opinions. However, it seems indisputable that more and more attention is being paid to the selection and training of all classes of employees. The larger corporations are becoming the leaders in this work, and rightly so, because the greater the number of employees in any one company, the more nearly will these employees approach to the average individual, unless special effort is made to procure for the company, men whose services will be better than average.

In the differentiation of individuals, first, by careful selection, and then in the appropriate education of the men thus chosen for employees, there is an opportunity to prove the economic loss involved in the labor union doctrine of the same wage and performance for every man belonging to the same trade. I have always felt that the splendid success of the Carnegie Steel Company established, once for all, the ad-

vantages to be derived from intelligent profit sharing, which I regard as the goal to be aimed at, after the employees have been properly chosen and educated.

In regard to the selection of employees, I feel that until the plan of a central employment bureau has been tried and found to be wanting, that the burden of proof is upon all companies large enough to use such a bureau and not having one. Also, either because of workmen's compensation acts, pension systems, or the natural desire of employing men fit in every respect, a medical examination would seem to be quite necessary. For two years, we have examined for sense of smell, all distribution employees liable to come into contact with gas. This examination has revealed only a few men in as many hundreds whose sense of smell was quite defective. We consider that the company has benefited by the knowledge that even those few men are not competent to pass upon a gas leak. In addition, as a result of this examination, we were able to give other men advice from which their physical condition has profited.

It is unfortunate that the benefit derived from paying more attention to the adaptability of the human element to various lines of work, is not as easily seen as is the case with many changes in inanimate material. In gas manufacture, for instance, the effect of changes in the treatment of raw materials, or in the materials themselves, will generally be quite apparent in immediate results. It is probably largely because of this inability to demonstrate results, that many executives do not look with more favor upon plans for the more careful selection of employees and for their training when selected. These plans invariably involve increased initial operating expense for extra employees, and because of such proposed increase, the plans are rejected, especially in what may be called "hard times," although of course, during a period of depression, operating economies are more strongly demanded than during a period of good profits, and each advocate of a plan for the improvement of employees feels certain that its result will mean an increased operating economy that will far outweigh

the small amount of expense necessary to bring about the improvement in employees.

THE ACTING CHAIRMAN: I will have to ask Mr. Reinicker to close the discussion.

MR. REINICKER: I wish to tell Mr. Rogers his point has been taken care of in the paper.

Mr. Althen has taken exception to a few of my statements regarding labor. I know this is a very difficult and dangerous subject, and is one that should be treated with great consideration, but the whole point I wanted to make was, the more we raise the standard of our men, the less likelihood we would have of labor trouble. Also, I wish to make a point that notwithstanding the fact that we have not as a gas company had much labor trouble, we are constantly employing the same class of men that are being employed elsewhere, and the trouble is cropping up. That is what I want to do,—to compel us to be on the job and be on our guard.

APPOINTMENT OF SECTIONAL NOMINATING COMMITTEE.

MR. WALTON FORSTALL (Philadelphia): I move that the Chairman appoint a committee of three to report to this section to-morrow morning the names of three men, whom they would suggest that the section recommend to the Nominating Committee of next year. The Nominating Committee must choose from one of those men next year, a Vice-President of the Institute, who will be considered as representing the Distribution Section and who will preside over the Distribution Section in 1916.

(The motion was duly seconded.)

(Mr. Reinicker again acted as Chairman.)

THE CHAIRMAN: You have heard the motion and it has been seconded. All in favor please say "Aye." The ayes have it. (Motion carried.)

I will name Mr. W. D. Kelley, Mr. G. R. Althen and Mr. C. C. Simpson for that committee.

THE CHAIRMAN: The meeting is adjourned.

Adjourned, 5:50 P. M.

DISTRIBUTION SECTION

Morning Session, Thursday, October 22.

Mr. C. E. Reinicker (Chicago), *Chairman,* Presiding.

Mr. J. Stilwell (New York), *Section Secretary.*

Chairman Reinicker called the meeting to order at 10:10 A. M.

The Chairman: I would like to get started, because we have a very interesting program this morning,—one on which there should be a great deal of discussion.

Before starting on the regular routine business, I wish to state that Mr. Simpson, being unable to serve on the Sectional Nominating Committee, I have appointed in his place Mr. G. I. Vincent.

The first paper to-day is "Proper Specifications for and Inspection of Interior Gas Piping," by Mr. A. E. Turner, of New York. Of all the subjects which have been presented and which are to be presented to this meeting, I do not think there is any of more importance than this paper, and I hope it will be discussed thoroughly.

PROPER SPECIFICATIONS FOR AND INSPECTION OF INTERIOR GAS PIPING.

Necessity for Standard Specifications.

At the present time, when such progress is being made in the utilization of gas for all purposes, the success of any appliance, whether for light, fuel or power, depends upon the quality of the service rendered by the company.

Broadly speaking, there are four divisions of any distribution system which contribute equally to the satisfactory supply of gas. These are: mains, services, meters and house piping, and they must all be of suitable size. The first three factors are controlled by the gas company and are usually adequate, but the house piping, which in most cases is not under the company's control, can throttle their functions to such an extent as to defeat their object—satisfactory service. There

is scarcely any redress from a faulty system of house piping after it is installed. The only remedy lies in the hands of the property owners, who cannot be readily moved to take steps to improve conditions.

In looking over the house piping specifications of several companies, I find that some are very explicit, while others are indefinite, and there is a large variation in the number of outlets allowed for various sizes of pipes. Also, as to the number of tests required, there is no uniformity. Some companies demand three, one as soon as the piping is installed, one when the building is completed but before the fixtures are up, and one after the fixtures are installed. Some require two, omitting the one after the fixtures are up, and others omit to test when the building is completed, before the fixtures are installed. There is also a wide difference in the requirements regarding the pressure at which the piping should be tested, varying from 6 in. to 12 in. mercury.

In some cities, the piping is installed according to specifications of a Municipal Bureau, under the supervision of inspectors of that bureau. In other cities the municipal authorities require that the piping be installed according to the specifications of the gas company which has the supervision of the work. Again, where there is no Municipal Bureau, the company requires that the work be done according to its specifications.

These varied conditions point forcibly to the necessity for some fundamental rules and regulations on the installation of house piping systems that will eliminate future troubles.

With this condition borne in mind, I have attempted in this paper to point the way to this end.

Present Practice in Some Large Cities.

In New York City, the law requires that prior to the construction or alteration of gas piping in any building or part of any building, a permit must be obtained from the Superintendent of Buildings. This permit will be issued only to a registered plumber. Application must be made and complete

floor plans filed showing each and every outlet, before beginning the work. Small alteration may be made by notifying the Bureau of Buildings, using the blank form provided for repairs and alterations to plumbing.

When the piping is completed, the plumber must apply, in the presence of an inspector of the Bureau of Buildings, a test with air to a pressure equal to a column of mercury 6 in. in height, to stand for 5 minutes; only mercury gauge shall be used. A fixture, gas heater or range shall not be connected to the piping until a card showing the approval of this test has been issued by the Superintendent of Buildings.

No meters will be set by the gas company until a certificate is filed with them from the Bureau of Buildings, certifying that the gas piping complies with the rules of that bureau. The inspectors of the gas company work in conjunction with the inspectors of the Bureau of Buildings in seeing that the piping is installed according to the rules and regulations of the Building Department.

In Chicago, it is required that all piping be installed according to the specifications of the Peoples Gas Light and Coke Company. The company's inspectors supervise the installation, and a certificate is issued by the company upon the satisfactory completion of the work. They request architects, builders and owners of buildings not to allow payment on bills for gas fitting, unless accompanied by the company's inspection certificate.

In Boston, the law requires that all gas fitters be licensed; that plans of proposed gas piping be filed with the Building Department for its approval; that the work be installed according to the rules and regulations of said Building Department. I am advised that the gas company also supervises the installation.

I am informed that in some cities where there are no municipal laws regarding the installation of gas piping, the gas company has more or less trouble in having the work done in compliance with its rules and regulations, and, in some instances,

could not enforce their rules because the architect had not given any definite specifications regarding the gas fitting, or the owner, being a speculative builder, did not care. The only points that the company could gain in these instances were that the piping was not trapped and that it stood the required test for tightness.

To aid in overcoming the difficulties where no laws govern gas piping, some companies, including the Laclede Gas Light Company, of St. Louis, have had the local association of master plumbers approve their rules and regulations, and have asked the co-operation of architects, owners and builders by having them embody in their specifications that all work be done in accordance with the rules and regulations of the company. This is done knowing that it will do much to aid the company in giving good service which will result in more satisfactory relations between the company and the consumers. The Laclede Company will not issue a certificate until the regulations are complied with.

In making a comparison between the benefits derived from city as opposed to gas company supervision, it depends to a great extent upon how thoroughly either is done. The municipal inspector is vested with authority to compel the fitter (under penalty of filing a violation) to install the work according to the specifications set forth in the city ordinances. The power of the company's inspector, where no municipal laws govern, is more or less limited. Of course, there is a wide difference in responsibility—the city inspector not being an employee of the company will probably not take the same interest in the company's regulations as the company inspector does. It is hardly expected that he should—if the piping is installed according to specifications, and proves upon test to be tight, the duties of the city inspector end there. Not so with the company inspector. He should at all times have the interest of the company and the prospective consumer at heart, and should, whether the specifications cover it or not, see that the work is executed in such a manner that the company's service, so far as the piping is concerned, will be entirely

satisfactory, thereby eliminating the chance of having a dissatisfied consumer.

It is just as important, and perhaps more so, that the piping be inspected and the installation watched in buildings undergoing alterations, as in new buildings. Many formerly perfect systems of piping have been so altered, and additional lines

5M. Form 1220-7-13

INSPECTION OF NEW BUILDING

Location

Kind of Building

Owner

Architect

Plumber

Plan of Piping

Stove Connections

Number of Meters

Ordered Service

What Service in

REPORTS AS TO PROGRESS OF BUILDING

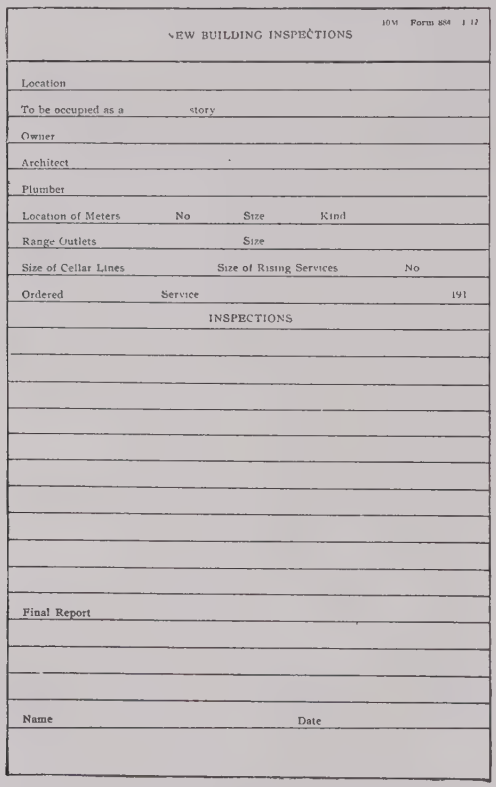
Fig. 1.—Building inspector's memorandum.

added thereto, as to make the service from such a system one of constant annoyance to the consumer and an expense to the company.

When a test is being taken by an inspector, it is very important that he makes sure, by loosening caps at different points in the apartment or building, that air is on the entire system

supposed to be under test, as there have been instances where sections indicating a slight leak have been cut off without the knowledge of the inspector, and, after his visit, have been reconnected to the passed lines.

The practice resorted to by some plumbers of filling lines



10M Form 884 1 12

NEW BUILDING INSPECTIONS

Location

To be occupied as a story

Owner

Architect

Plumber

Location of Meters No Size Kind

Range Outlets Size

Size of Cellar Lines Size of Rising Services No

Ordered Service 191

INSPECTIONS

Final Report

Name Date

Fig. 2.—Shop record of new building inspections.

indicating small leaks, with water and acid or some other liquid, for the purpose of rusting up the leak, should not be permitted, because, while it might rust up the leak and thereby pass the test, tightness secured in this manner may not last, and anyway it causes rust to form on the inside of the piping, which will eventually become loose and collect in some fitting, thereby causing a stoppage.

As I am familiar with the system of inspection in New York, it may be of value to explain it here: A copy of the "Real Estate Record and Builders' Guide" is delivered weekly to the district shops. This guide contains the list of all proposed new buildings and alterations to buildings from which the company's building inspector makes out a memorandum (Fig. 1) for his own use and also a card (Fig. 2) for the shop record. He makes periodical calls at the building during its construction or alteration, advising the plumber as to the proper sizes and location of piping; the proper location of meter and the proper termination of piping so as to facilitate the setting of meters. He also inspects the installing of piping to see that it conforms to all the specifications of the Bureau of Buildings, and that it is installed in such a manner to eliminate as far as possible any chance of complaints; that all piping is so graded that condensation will not collect in it; that all horizontal or vertical piping, drops and outlets are properly fastened; that a fuel line of proper size is run from the meter to supply the appliance to be installed.

On each inspection, he notes on his memorandum the condition of the work and what, if any, suggestions he made, and upon his return to the shop, posts the information on the shop card record, which record is not complete until the registered number of the Bureau of Buildings' certificate, and the date on which the meter was set, are noted.

Suggested Specifications.

In making the following suggestions for standard specifications, I have taken the liberty of using some of the information contained in the following:

Rules and Regulations of Bureau of Buildings—City of New York.

Gas Fitting Laws, Building Department—City of Boston—Boston Consolidated Gas Company.

Specifications of Fuel and Illuminating Piping—The United Gas Improvement Company, Philadelphia, Pa.

Gas Fitters Rules—Peoples Gas Light & Coke Company, Chicago, Ill.

Gas Fitters Rules—Laclede Gas Light Company, St. Louis, Mo.

Specifications for House Piping—Building Code—Consolidated Gas, Electric Light & Power Company, Baltimore, Md.
Specifications for House Piping—Consumers Gas Company, Reading, Pa.
Specifications for House Piping—Omaha Gas Company, Omaha, Neb.
House Piping Rules—Providence Gas Company, Providence, R. I.

Pipe.

All gas pipe should be of the best quality wrought iron or steel and of the kind classed as standard.

Fittings.

All fittings (except stop cocks and valves) should be of heavy malleable iron. Galvanized fittings are preferable, there being less possibility for the existence of sand holes. The use of cast iron fittings is prohibited.

Defective Material.

Split pipe or defective fittings repaired with white lead, cement, or in any other way, will not be accepted. Defective parts must be cut out and replaced with perfect material.

Material Not Permitted.

Unions must not be used where the work will be concealed; right and left couplings or long threads should be used. Bushings should not be used in concealed work; when necessary to reduce size, a reducing fitting should be used.

Smallest Size Allowed.

No piping of less than ⅜ in. in diameter shall be used.

Obstructions and Jointing.

As most of the pipe is cut on the job by means of hand cutters, the reaming out of the burr, especially in the smaller sizes, is very essential, otherwise an obstruction is left in the pipe which might reduce the flow and provide a lodging place for pipe scale or rust, which may eventually result in causing complaints of poor supply. Another practice that might cause the same trouble is that of applying red lead, or other jointing compounds, to the female threads of fittings, instead of to the male thread of pipe. Therefore, all piping should be free

from obstruction; all burrs should be removed and each piece stood on end, thoroughly hammered and blown through before being connected, to remove any dirt, rust or scale. White, red lead, or any other jointing compound should be applied sparingly to the male thread of the pipe, and not the fitting, to avoid clogging the pipe. The use of gas fitters' cement is prohibited. No piping should be painted or coated until inspected and passed by the Company.

Riser Location.

Where there is only one riser in a building, it should not be less than ¾ in., and should extend to a point within 3 ft. of the head of the service and to the right of it, when facing the service. Where there will be more than one tenant in a building, the company will set as many meters as there are separate consumers, provided that a separate riser be run for each consumer. Where all the meters will be located at one point, these risers should not be scattered but drop together in alignment to the basement at a convenient point, with a clear space of not less than 3 in. between any two of them, and be extended horizontally to within 3 ft. of the proposed location of the meters at the right. Where the meters will set in separate apartments, the riser must be extended to within 18 in. of the outlet on house service and to the right of it.

Building Service Opening.

The opening on a building service should always be on the left side of the riser which it is to supply, and not less than 18 in. from it.

Riser, Bottom of, Accessible.

It should never come down an exposed wall, nor extend more than 2 in., or less than 1 in., below the bottom of floor beams. Where the riser is extended horizontally to a meter location, a tee with full sized opening looking down, must be put on the bottom of the vertical pipe. Risers should not terminate in a place where beams, girders, or heater pipes, which will be put up subsequently, will interfere with making connection to meter. In case the bottom of the riser is to be

located on a masonry wall, it must be offset by using a 45 deg. ell, placed so as to bring the bottom of the riser clear of the foundation wall. The dropping of a riser on the ledge of a foundation wall with a 90 deg. ell or tee plugged, but inaccessible, will not be permitted. The use of short nipples and caps or special long round headed plugs for the tees on the bottom of risers, is advisable, as the square headed plug has such a small surface for wrench hold, that in some cases the square corners have become so worn that its removal is rendered difficult, and in some cases cutting out has to be resorted to.

Meter Location.

Meters should not be set higher than 6 ft. 3 in. from the floor to the bottom of the meter. The company should reserve the right to determine the location for the meter, and it should not be set where it will be liable to injury or exposure to dampness, frost or extreme heat. The meter and connections should be easily accessible in order that the index may be easily read and the meter cock turned.

Prohibited Meter Locations.

Under sink or wash-stand.

Horse stall or any place in a barn where it would be liable to injury.

Sleeping apartment.

Stairway closet. Bedroom closet.

In the way of toilet flush tank.

In a closet that is not properly ventilated by means of an opening close to ceiling. (In many instances, these closets are ventilated at the time the meter is set, but after all inspections have been made are then closed tight.)

Under stoops.

Near furnaces or ovens.

Breaking Sizes.

No extension must be made from a pipe of a smaller size. In every case connection must be made at a point where the full size can be maintained.

Grading of Pipe.

All pipe should be run as directly as possible without traps, with a constant grade toward risers, meters, or mains, and the entire system so graded as to empty completely the water of condensation at the lowest point. Should it be necessary for this purpose, drips shall be provided. Piping may also be run level. All branches should be taken from sides or top of running lines, not from below.

Main risers and branches to be of a size sufficient to give ample and full supply of gas to all fixtures and other appliances in the building, when all are lighted and in use.

Pipe Fastening.

No pipe shall be laid to support any weight (except fixtures), or to be subjected to any extra strain whatsoever.

All piping shall be rigidly fastened by hooks or straps, which are nailed or screwed to woodwork, or where masonry walls form the base for fastening, the wooden plugs or metal expansion plugs inserted in these walls.

Horizontal runs of pipe should be supported or fastened by hooks, or straps, or pipe hangers securely fastened, at short intervals such as 6 ft. for ⅜ in. and ½in., 8 ft. for ¾ in. and 1 in., 10 ft. for 1¼ in. and 1½ in., and 12 ft. for 2 in.

Where piping does not run sufficiently close to woodwork to admit of its being securely fastened, wooden strips, spaced as above, should be provided. The ends of these strips should be fastened to wooden cleats, which are nailed or screwed to floor beams or studding.

Where iron beams, concrete or tile are used in the construction of floors or partitions, the piping, whether concealed or exposed, should be supported and fastened in a manner suitable to the company.

All drops and side outlets should be rigidly attached by flanges, hooks or straps to the frame work of building. If there is not adequate fastening located at the back of the outlet, a strip as described above, or some other means of fastening, satisfactory to the company, should be provided.

Piping should not be run to the bottom of beams that are to be covered with lath and plaster, but should be run along the top of the beam or joist where it is possible, so that it will be accessible by raising the floor boards, which, when covering such piping, should be fastened with brass or other non-rustable screws.

Where running line or branches cross beams, they must do so within 36 in. of the end of the beams and in no case shall the said pipes be let into the beams more than 2 in. in depth.

Piping should not be laid under tiled, parquet, or mosaic floors where it can be avoided. In some cases the piping may be left exposed below the ceiling; when beams or girders are left exposed, piping may be concealed by a moulding.

Imbedding in Concrete or Cement.

The pipe should be painted with two coats of heavy red lead or asphaltum before being imbedded in cement floors, or it may be laid in conduit pipe.

Pipe on Masonry Walls.

It is preferable, where vertical pipes must be concealed, to locate them in hollow partitions, rather than behind the studding or lathing back of plastering, on masonry walls. Where it is absolutely necessary to run pipe on a masonry wall, a furring strip must be placed between the pipe and the wall, and the pipe securely fastened to the wall by strapping it to wooden plugs, or metal expansion plugs, imbedded in the wall.

Encasing Pipe in Masonry Wall.

Where gas lines pass through masonry walls, they must be encased and the pipe left resting on the bottom of the casing with at least ¾ in. clearance on top.

Drops.

Ceiling drops should have a set of 4 in. and project not less than ⅝ in., nor more than 1½ in., below a finished ceiling, and should be firmly secured and plumb. Side wall outlets may be either square bends or long drop ells, and project not less than ⅝ in. or more than ⅞ in., and should be at right

angles to the wall and firmly secured, and where practical, must rise from below and not drop from above.

Outlets for Illumination.

Outlets for illumination must not be placed under tanks, back of door or within 4 ft. of any meter.

Outlets for Fuel.

When the pipe has been run under the floor, the fuel outlet in the kitchen should be brought up 3 in. above the floor and 2 in. clear of the baseboard. When the pipe has been run from overhead, the outlet should be left 3 ft. above the floor and 2 in. clear of the finished wall; in either case, the size of this line should not be less than ¾ in. from outlet of meter to outlet of range pipe.

Capping Outlets.

All outlets must be capped with iron caps until fixtures or appliances are installed.

Inspection of Piping.

Piping should be inspected as early as possible after it is installed and before it is covered by flooring, plastering, etc. It should again be inspected after the building is completed and before the fixtures are hung, and again when all fixtures are up. In each case, 24 hours notice is required; gas fitters are expected to have tested and completed the piping and found it tight, before notifying the company to make an inspection. All tests should be made with a mercury column gauge.

Testing.

Before fixtures are installed, piping must stand a pressure of a column of mercury 6 in. high without any perceptible drop, for 10 minutes. The air pressure must be up to all caps, and any valves in line must be opened. After all fixtures are installed, the piping must stand a pressure of a column of mercury 1 in. high without any perceptible drop for 10 minutes. All defects disclosed by tests should be permanently repaired with perfect materials.

Piping Schedules.

At the present time, when gas is being used for so many purposes other than illumination, it seems advisable to follow the practice of some companies and express the amount of gas the piping may be called on to deliver in terms of outlets, instead of in terms of burners. As the consumption of gas through a ⅜ in. outlet is approximately 10 cu. ft. per hour, the ⅜ in. outlet has therefore been taken as a unit, and is to be used in estimating the size of pipe necessary to give an adequate supply of gas.

In estimating the number of outlets to be supplied, use the following schedule of relative values which are based on the actual area of pipe:

	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
Size of outlet.....	½	¾	1	1¼	1½	2	3
Value of ⅜ in. outlet..	2	3	5	8	10	18	40

To determine the amount of gas passed by various size pipes at different lengths and 2/10 and 4/10 differential pressures, the writer had tests made by burning the gas in cluster lights, the drop in pressure being indicated on a very sensitive differential draft gauge. The consumptions were registered on a wet meter for small sizes and on a dry meter for the larger sizes. Straight pipe properly reamed was used.

In figuring the following tables, excepting the Gas Engine table, I have taken for a basis the consumption shown at 2/10 differential pressure for all sizes and lengths and have deducted 50 per cent. from the consumptions as shown for ⅜ in. to 1 in. pipe inclusive, and 35 per cent. from the remaining sizes to compensate for losses in consumption due to pipes being of irregular bore, burred, friction due to fittings, etc.

With a view to having a standard form of table the schedules are shown in the forms used by some companies, for the purpose of comparison.

OFFICE BUILDINGS, DWELLING HOUSES AND FLATS.

Size of pipe (Inches)	Pipe allowed (Feet)	Number of ⅜ in. outlets
⅜	20	1
½	30	1
¾	50	4
1	70	6
1¼	100	13
1½	150	16
2	200	25
2½	300	35
3	400	50
4	500	75

NOTE—In any room where the ceiling is 20 ft. or more high, the drops must not be less than ¾ in. pipe.

STORES AND FACTORIES.

Size of pipe (Inches)	Pipe allowed (Feet)	Number of ½ in. outlets
½	30	1
¾	50	2
1	70	3
1¼	100	6
1½	150	8
2	200	13

NOTE—In stores the running line must not be less than ½ in. to the last outlet. All outlets for drops in stores must be ½ in.

GAS ENGINE.

Horse-power.	Size of pipe (Inches)	Pipe allowed (Feet)
1 to 7	1	50
8 to 12	1¼	50
13 to 22	1½	50
23 to 35	2	50
36 to 50	2½	50
51 to 100	3	50
100 to 150	4	50

NOTE—An independent line should be run from meter to supply a gas engine and an equalizing holder, anti-fluctuator, or other similar device of ample size installed to prevent any fluctuation or variation in the gas pressure in the vicinity of the engine.

Required Sizes of Piping for Various Lengths and Number of Outlets.

No. of ⅜ in. outlets	Size of pipe in inches									
	⅜	½	¾	1	1¼	1½	2	2½	3	4
1	20	30	50	70	100	150	200	300	400	500
2		25	50	70	100	150	200	300	400	500
3		15	50	70	100	150	200	300	400	500
4			50	70	100	150	200	300	400	500
5			30	70	100	150	200	300	400	500
6			25	70	100	150	200	300	400	500
7			15	60	100	150	200	300	400	500
8			10	50	100	150	200	300	400	500
9				45	100	150	200	300	400	500
10				35	100	150	200	300	400	500
11				30	100	150	200	300	400	500
12				25	100	100	200	300	400	500
13				20	100	150	200	300	400	500
14				18	80	150	200	300	400	500
15				15	70	150	200	300	400	500
16					60	150	200	300	400	500
17					55	130	200	300	400	500
18					50	120	200	300	400	500
19					45	110	200	300	400	500
20					40	100	200	300	400	500
25					25	60	200	300	400	500
30					15	45	150	300	400	500
35						30	120	300	400	500
40						25	100	270	400	500
45						20	75	250	400	500
50						10	60	180	400	500
60							45	120	300	500
75							25	100	200	500
100								45	100	400
125								30	75	300
150								20	50	200
175									40	150
200									30	120
250									20	85
300										50
350										40
400										30
500										20

COMPARISON OF ACTUAL SIZES OF PIPE WITH THE THEORETICAL SIZE.

Theoretical		Wrought iron or steel	
Inside diameter	Area square inches	Actual inside diameter	Area square inches
3/8	.11045	1/2	.19635
1/2	.19635	5/8	.3068
3/4	.44179	27/32	.55913
1	.7854	1 3/32	.93956
1 1/4	1.2271	1 13/32	1.5532
1 1/2	1.7671	1 5/8	2.0739
2	3.1416	2 5/32	3.6516
3	7.0686	3 1/8	7.67

(Mr. Turner read an abstract of his paper.)

THE CHAIRMAN: Gentlemen, you have heard Mr. Turner's abstract. The paper is now open for discussion.

MR. WALTON FORSTALL (Philadelphia): I have been interested in the question of house piping for a great many years, and I agree with the Chairman that it is one of the most important subjects with which we have to deal. Without adequate interior piping, good gas service is impossible, and yet I fear there are many gas companies in this country who are more or less powerless to ensure the proper installation of interior piping. The public has been thoroughly educated as to the dangers of sewer gas, and, indeed, it is now stated that some of the plumbing precautions which we have all agreed upon, are really unnecessary. Also, in water piping, most people appreciate that you cannot expect to get much water through small pipe. Gas, unfortunately, is not visible, and almost the first thought that enters the consumer's mind when he is not obtaining sufficient light, is that the trouble is due to a poor quality of gas, and not that the size of the piping may be too small. Personally, I believe that inadequacy in size and lack of tightness in both piping and fixtures have been two of the controlling reasons why the average householder is ready to consider electric lighting, once he feels that the cost is not

much greater than that of gas. Therefore, it would seem quite imperative that the gas companies of this country should take united action in impressing upon State and municipal bodies, and upon the general public, the importance of proper gas piping. Naturally, the first step is to agree among ourselves as to what is desired. For this purpose, this paper should make a good starting point for committee work next year, so that at its next meeting the Institute could, after several months of prior criticism, vote intelligently upon the adoption of standard specifications. In drawing up these specifications, I think it will probably be found that special schedules, such as the ones shown on page 1325 can be largely, if not entirely, avoided. In other words, I see no reason why the amount of gas needed at any one point should not determine the size of the pipe, entirely independent of what this gas is to be used for.

This simply means that in every case you will figure on 100 per cent. load factor for each outlet. The cost of the piping itself is such a small proportion of the cost of any building, that the assumption of this 100 per cent. load factor cannot be objected to as an unnecessary expense.

Looking for a moment beyond the adoption of such specifications, a strong effort should be made to convince State Commissions that in their work for good gas service, this question of housepiping should not be overlooked. It would probably happen that very often through the State Commissions, pressure could be brought to bear upon municipal bodies who were not willing to delegate the proper authority to the gas companies, for undoubtedly the least burdensome and most efficient and most economical way of enforcing housepiping regulations is through the gas company. Gas company regulation will always be more flexible and better able to respond to peculiar conditions than any municipal regulation. If proof were needed of this, experience in Philadelphia for 15 years would furnish a complete demonstration. During that time, every house has been piped in an adequate

manner, and there has been a wonderful improvement in the character of the fixtures used. Yet with all the changes thus necessitated, the situation has been so well handled that there has been practically no friction with the various gas fitters and fixture dealers, who, with the gas fixture manufacturers, are willingly aiding the gas company to improve service to the consumer.

Mr. J. P. Hanlan (Newark): On page 1323 of Mr. Turner's paper, under "Outlets for Fuel," attention was called only to the fuel outlet running to the kitchen to supply gas range and water heater. Now, it seems to me in these days when we have so many good appliances, such as gas reading lamps, fireplace heaters, grates and gas logs, gas heating stoves, chafing dishes, percolators and vacuum cleaners for use in large residences, mention should be made of outlets for such purposes. I do not know whether any of us appreciate how fast the heating business is growing, and how fast it would grow if we grow with it. I believe before this paper is placed in the Proceedings of the Institute, that there should be a section added to the present one, calling attention to the necessity of equipping every room with at least one fuel outlet, and fireplace outlet where there are fireplaces.

The Chairman: I think your point is well taken and I shall make it my business to call proper attention to your request. Is there any further discussion?

Mr. H. R. Sterrett (Philadelphia): Mr. Turner's paper has so comprehensively covered the subject, that but little can be added in the way of discussion. The importance of a specification which will thoroughly cover the installation of all interior gas piping, cannot be too greatly emphasized. In order that such a specification be of any real value, it is very necessary that proper laws be enacted to insure to the gas company the enforcement of the various rules embodied in the specification.

In Philadelphia, where about 375,000 meters are in use, the city government, by ordinance, requires the gas company to

exercise a supervision over the character of material used and work done in installing gas piping and fixtures. In accordance with the obligation thus created, the company has adopted a specification for fuel and illuminating piping and fixtures, similar in many respects to the suggested specifications as outlined in Mr. Turner's paper. The inspectors are employees of the gas company, impartial, and working for the combined interests of consumers and company.

Accompanying the gas fitters request for inspection, which is made while the piping is still exposed, and includes a pressure of 3 lbs. per square inch or 6-in. mercury column, which must be sustained for a period of 10 minutes, is a plan of the proposed system, or extension, plotted on a form provided by the gas company.

The plan is compared by the inspector with the actual installation, and if the rules have been complied with, a certificate of first inspection is issued and the piping may be covered. If any changes are necessary, they must be made before the certificate is granted.

After all carpenter and other building work that might disturb the piping has been finished, and after the last coat of white plaster is on, the gas fitter should apply for the second inspection, which is principally one of pressure and is made before any fixtures are hung. A pressure test identical with that of the first inspection is made, and if the piping is tight, a certificate of second inspection is given.

After the fixtures are installed and the system is ready to receive gas, third inspection should be applied for. This, the last inspection, is principally one of fixtures; the entire system is put under a pressure of 6-in. water column, which must show no drop in 10 minutes. Fixtures are examined for poor workmanship, objectionable design, etc., and all gas fixture cocks are carefully measured with a special gauge made for the purpose, to determine whether they comply with the fixture cock specification. I might say that about 2 years ago, a standard Philadelphia fixture cock was designed and included in the

gas company's fixture specification, which comes under the third inspection. At first, many of the manufacturers and dealers were rather antagonistic to the adoption of any new form of fixture cock. To-day, after two years, the new cock is used on all fixtures, has the hearty approval of those same manufacturers and dealers, and will no doubt save the gas company hundreds of dollars which have been in the past charged against fixture cock leaks.

On page 1323 of Mr. Turner's paper, under "Outlets for Fuel," the minimum size pipe to be used in running an independent stove line is given as ¾ in. I would suggest that this be increased to 1 in. since the maximum consumption of the ordinary gas range is about 100 cu. ft. per hour, and the data contained in Fig. 3, page 1327 shows that using a 0.2-in. drop in pressure, 50 ft. of ¾-in. pipe will not pass this quantity of gas. In addition, a circulating water heater is often connected to the stove line, and this increase of about 35 to 60 cu. ft. per hour makes a 1-in. line necessary in order to insure good service on a low pressure distribution system.

The only other suggestion I would offer is that on page 1324 under "piping schedules," the number of ⅜-in. outlets which the various sizes of pipe are equivalent to, be in proportion to the relative areas. The values assigned above the ½-in. size are lower; for instance, 1½-in. pipe is given as equivalent to ten ⅜-in. outlets, whereas the relative areas show it to be equal to sixteen ⅜-in. outlets. Since the friction is less per cubic foot of gas passed, the larger the pipe, there is no reason why the full value cannot be assigned to pipes larger than ⅜ in.

Mr. A. M. Knapp (Yonkers, N. Y.): On page 1320, under "Prohibitive Meter Location," it reads: "Under sink or washstand, horse stalls or any place in a barn where it would be liable to injury"—then it goes on and gives the list. I say in the kitchen, but I will take exception of course to all-gas kitchens, but the kitchen is the warmest room in the house day in and day out. From a meter shop point of view, I think

that would be a very bad location for a meter, because it is warm, and we are given to understand a meter should be set 6 ft. 3 in. from the floor. If a meter is set 6 ft. from the floor, that gives you about 2 ft. space from the ceiling to the meter. If a meter goes out of the shop not having a test made, or the diaphragm examined, it is not known whether the diaphragm is water soaked or not. If subject to the heat of the kitchen, in three months or so there would be practically a non-register meter. So I think the better place to set the meter would be in the toilets. If it is a regular meter, the dial could be seen easily and the meter could be read without any climbing at all.

Mr. G. I. Vincent (Des Moines): I have made a few running notes on this paper, from an experience based on a plant of moderate size. I would like to have Mr. Turner understand that they are not criticisms; they are merely suggestions.

While this is not the first paper on this subject which has been presented to gas associations in this country, I believe I am safe in saying it more nearly covers the matter explicitly than any discussion which has heretofore appeared.

Pipe.—For the sake of brevity, I think it would be best to specify full weight pipe. This would not possibly cover the matter, but I doubt if it can be covered except by much detail, which probably would be better avoided. What I mean is, that I think it would be out of the question to force the issue of first grade pipe unless some brand were specified. Of course, defective pipe should be caught by the pressure test if not by casual inspection.

Fittings.—I do not see why it is not advisable to specify galvanized fittings altogether, although I understand that one large municipality explicity prohibits them. Also, I do not see the necessity for explicitly prohibiting cast iron fittings.

Material not Permitted.—I question the advisability of suggesting the use of right and left couplings in any gas work. There are some occasions when they are entirely satisfactory,

but usually not. I do not think it is necessary to prohibit the use of bushings in concealed work. Some years ago bushings were not entirely satisfactory, but I think this is no longer true.

Smallest Size Allowed.—Making the limit 3/8 in. is probably satisfactory for the issuing of instructions to fitters and architects. There are occasionally situations where 1/4 in. and even 1/8 in. may be desirable, and it is questionable in my mind whether this should not properly be touched on in specifications of this kind.

Obstructions and Jointing.—I believe we are justified in insisting on reaming as a part of the installation work, and I do not think it is necessary to discuss the reason for it in issuing the specifications. Also, I believe the insistance on using jointing material on the male threads only, should be enforced.

Riser, Bottom of, Accessible.—In this paragraph is recommended the use of special long round headed plugs. For the sake of brevity, and due to the fact that these plugs are not stock fittings, I would suggest cutting it out and recommending short nipple and cap only.

Drops.—The use of bent pipe for drops is not prohibited. Whether this was purposely omitted or not, I do not know, but suggest that it should be considered. Bent drops I know are considered good practice by many good fitters and I understand have been approved by a number of superintendents and engineers.

Outlets for Illumination.—By specifically prohibiting locating outlets in three places, it might be inferred that any other place would be acceptable, which, of course, is not the intent of the paragraph.

Inspection of Piping.—In common with a number of other engineers, I have found one inspection of the piping to be satisfactory, this inspection being made when the pipe is enough exposed that it can be thoroughly examined, and the pressure test being made at that time. No subsequent test seems to be

necessary on the piping except that made when setting the meter.

Mr. G. S. Barrows (Philadelphia): Referring to "gas fitter's cement," I would like to ask if we have any clear understanding of the difference between "gas fitter's cement" and "plumber's cement?" I do not know what the difference is, but I understand that there is in the trade a clearly defined difference, "plumber's cement" being much more elastic than "gas fitter's cement," which is practically the same as sealing wax and is very brittle.

I believe that we should look into this matter, for cement of some kind is very desirable for certain classes of work, particularly the making up, and installation of, combination fixtures.

Mr. G. R. Althen (Baltimore): I note on page 1318 Mr. Turner states that interior gas piping should be of the best quality wrought iron or steel. I would like to ask Mr. Turner whether he has gathered any data covering the comparative qualities of both kinds of pipe?

I note on page 1319 that the statement is made that risers should be located within 3 ft. of the head of the service. I am of the opinion that not more than 2 ft. should be allowed.

The suggestion is made that piping be encased in masonry walls. This practice should be discouraged, particularly where the piping is exposed to dampness. The opening should be securely cemented or plastered, to prevent corrosion.

The Chairman: Has anyone anything else to add to this discussion? I am sorry Mr. Keppelmann is not in the room, because I understood that in the discussion of this paper, he was going to suggest the idea of doing housepiping by cutting openings and welding on branches as necessary, thus doing away entirely with fittings. From what we saw and heard yesterday on the subject of welding, this may not be such a far-fetched idea as it sounds. Is there any further discussion on this paper? If not, Mr. Turner will please close the discussion.

MR. TURNER: Before writing this paper, I wrote to various companies requesting information relative to this subject. From the information received from this and other sources, I have tried to present this very important subject in such a manner as to promote discussion.

I realize that conditions and practices vary in different cities. What is permissible in some cities would be prohibited in others, consequently, I am very much surprised at the lack of criticism and the small number of suggestions offered.

I had hoped that the arguments and suggestions which I had expected, would have aided the Committee in its work of preparing the "Standard Specifications for Interior Gas Piping."

As piping schedules are based on the pressure differentials allowed, it would not be advisable to have a standard schedule, as the company having an initial pressure of 10 in. water would consequently specify pipe of a smaller diameter than would the company having an initial of 3-in. water pressure.

In answer to the suggestion of the gentleman from Newark, relative to the number of outlets being specified, I fully agree with him, and I had hoped to bring out considerable discussion as to the number and the location of these outlets.

In answer to Mr. Sterrett's suggestion, that a range line should not be less than 1 in., I think that this is a matter for the Committee to decide upon, as the size of pipe is governed by the pressure differential.

In answer to Mr. Knapp's suggestion, that meters should not be set in kitchens, I would say that in New York City where there are very many apartment houses, we find the kitchen a very convenient place to set the meter. He recommends that they be located in bath rooms. In New York, we find this location not advisable, as meters so located are inaccessible. If it was a prepayment meter, the consumers in many cases would be inconvenienced when putting coin in meter, as they would be compelled to stand on the toilet seat, or edge of bath tub, sometimes grasping the meter or its connections for support,

which has a tendency to create leaks. If the bath room is occupied at the time the indexer calls, it probably means that another call will be necessary to get the index.

In answer to the recommendation, that the use of cast iron fittings should not be prohibited, I would say that in New York City we have had instances where these fittings have been used on rising services, and when the building settled, causing this rising service to be subjected to a strain, the cast iron fitting broke off, thereby causing a leak. That is one reason for prohibiting their use.

In answer to the remarks relative to the use of right and left couplings, I consider them one of the best connections when properly used, and I know of no reason for prohibiting them.

Regarding the suggestion, that bushings should not be prohibited in concealed work, I would say that some bushings are made of cast iron and others of malleable iron, and I have known of instances where, when the gas piping was subjected to a strain, the bushings have broken off, thereby causing leaks. I think we are right in specifying ⅜ in. as the smallest size pipe to be used in housepiping. This, of course, does not pertain to fixtures.

Regarding the suggestion, that one inspection of piping would be sufficient, I would say that in our experience in New York this would not be advisable, as the first inspection is usually made before the floors are down, and as considerable damage could be done to the piping before the building is completed, it is necessary to make a second test, and some companies demand a third test after fixtures are hung.

My reason for specifying both wrought iron pipe and steel pipe was that some architects specify that "Byers" wrought iron pipe be used.

I am informed that the National Tube Company manufactures steel pipe which they claim is equal to wrought iron pipe. Steel pipe costs much less than wrought iron, the price of some sizes being one-half that of wrought iron.

Regarding the termination of the riser, I specified within 3 ft. of the head of the service, because I considered as the head, that part of the service which projects through the foundation wall. If we were to specify 18 in., it seems to me that we would not allow enough space to properly set a meter.

Regarding encasing pipe in masonry walls, I do not see any reason for filling in the space between the pipe and the casing, as the walls to which I refer are interior walls and are therefore not exposed to the elements.

THE CHAIRMAN: Gentlemen, you have heard Mr. Turner's rebuttal. Before closing, I want to thank Mr. Turner in the name of this Section for the conscientious and excellent work which he has done. I sincerely hope that it will start something.

MR. VINCENT: Would it be in order for this Section to recommend to the incoming Technical Committee that a Committee on Housepiping be appointed?

THE CHAIRMAN: I think that is perfectly in order, Mr. Vincent.

MR. VINCENT: I make that motion.

THE CHAIRMAN: Is there a second to that motion?

(The motion was seconded.)

THE CHAIRMAN: Gentlemen, the motion is to recommend to the incoming Technical Committee the appointment of a Committee on Housepiping. It has been regularly moved and seconded. I wish to put it to a vote. All those in favor please say "Aye." The ayes have it. The motion is carried.

Before proceeding with the next paper, I will call upon Mr. Kelley to present the report of the Sectional Nominating Committee.

REPORT OF THE SECTIONAL NOMINATING COMMITTEE.

MR. W. D. KELLEY (New York): The Committee recommends the following gentlemen: Mr. J. D. von Maur, of St. Louis; Mr. D. E. Keppelmann, of San Francisco; Mr. G. T. Macbeth, of Mt. Vernon, N. Y.

THE CHAIRMAN: Gentlemen, the Committee recommends the above gentlemen as the nominees of the Distribution Section to next year's Nominating Committee, from which to choose a Vice-President, representing that Section. I am now going to put that to a vote. All those in favor of these names, please say "Aye." The ayes have it. It is so ordered.

THE CHAIRMAN: The next paper on our program is the report of the Committee on Piping Large Buildings for Gas, by Mr. O. H. Fogg, of New York, Chairman.

Before this Committee presents its report, I wish to call to your minds an incident which recently occurred, as being indicative of the responsibility and the work of this Committee. Last May, in Chicago, there was a meeting of the National Fire Protection Association. The Committee on Fireproof Construction brought in a report, one of the items of which was very disparaging to gas. It ran something like this: "We recommend that electricity be used in preference to gas for illuminating purposes, and where gas is used . . ."; then it went on to give the way in which it should be handled. There happened to be a representative of the gas industry in the room at the time, who raised a very vigorous objection to that statement, and unless we can so forcibly bring to the attention of various associations the falsity of a lot of popular notions, we are going to be constantly on the defence and we will be gradually beaten down. It certainly is up to us to put up a big fight. Therefore, this Committee report is at this time particularly pertinent and should be freely discussed.

REPORT OF THE COMMITTEE ON PIPING LARGE BUILDINGS FOR GAS.

PREFACE.

In this age of efficiency, the commercial world is making use of every means which will increase the economy and efficiency of its operations. Thus we find many sources of energy available for the production of mechanical work. Among those is found gas, unsurpassed as a convenient

source of energy that can be applied to the lighting, fuel and power fields with an efficiency second to no other source, and with a distinct pre-eminence in reliability, convenience, control, safety, operating efficiency, operating cost and space economy.

MILBURN, HEISTER & CO.
ARCHITECTS, WASHINGTON

The Bureau of Engraving and Printing in Pekin, China.

Piped throughout for Gas.

Why not every Government and Public Building in the United States?

Notwithstanding these often demonstrated and well known advantages the fact remains that, through the lack of knowledge of these points on the part of the architect or builder, or because of failure of gas companies aggressively to present this phase of the situation to those interested in new building construction, many of the large and important buildings erected, particularly those of the class known as "office, loft and light manufacturing and public and government buildings," have no provision for the use of gas. Therefore, your committee has endeavored to record the facts of the case in a comprehensive and authoritative manner so that they may

be presented to those most vitally interested, since it believes that when more fully informed they will not intentionally deprive the commerciai world of the possibility of using gas, so efficient an agent in the lighting, fuel and power fields.

Primarily, the object of this report is to bring before the gas industry, the great importance of concerted, aggressive action in urging and encouraging the piping of large buildings for gas. Your committee does not feel that the need for such action will be questioned, nor does it believe that there can be any just criticism of the frank declaration that this subject is one which has suffered sadly from neglect in the past.

Throughout the country generally, the number of large buildings erected is continually increasing. Our commodity lacks nothing in merit, indeed it has many advantages when compared with other sources of light, heat and power. It is true that in some localities there is a decided effort made to induce the installation of gas piping systems in such buildings and where made this effort is amply rewarded, but the fact remains that this important subject does not receive the proper attention generally and that the gas industry is decidedly the loser thereby.

It is not the purpose of your committee to present an argument in favor of the piping of large buildings for gas illumination only. There are many other demands for gas service which may and do arise in buildings of this class and which cannot be met because no gas piping system (or else an inadequate one) was installed at the time the building was erected. In short, it is this lamentable inactivity which frequently loses to the gas industry what might be made to prove a very lucrative field for the utilization of gas. It is all the more lamentable when we consider that in many cases, the former buildings that occupied the site of the present skyscrapers were good gas consumers. Where an aggressive policy of exploitation is lacking, it is no exaggeration to say that the increasing number of large buildings erected yearly tends to restrict rather than increase the field for the development of the gas business.

Your committee feels that this matter should be put before the gas industry in no uncertain terms and that the members of the American Gas Institute should be strongly urged to apply aggressive measures to the task of inducing architects, builders and owners of large buildings to provide at the time of erection a complete gas piping system, for no building can truly be considered modern otherwise.

Armed with the information and arguments here given each gas company should make strenuous efforts to secure gas piping in every large building that may hereafter be erected in its territory. The booklet recommended in the latter part of this report will, when issued, undoubtedly be of great assistance, but no gas manager is warranted in postponing such efforts until the publication of this book. No book will fit the peculiar details of each case, and consequently each manager can best work up his own arguments, using such of the facts and figures here given, as may be most effective. It is not intended that this report be circulated among architects and builders, but it is simply to form a basis from which the gas companies may derive information for any work in securing the piping of large buildings for gas.

History of Gas Manufacture.

In treating the piping of large buildings for gas, a short history of the manufacture of artificial gas is necessary.

Artificial gas, made from the distillation of coal and other bituminous fuels, was one of the earliest agents given the world for lighting, heating and power. From the year 1180, when coal was first systematically mined in England, through the period up to 1609 when Van Helmont in Brussels, first gave the name "gas" to the aeriform bodies produced by combustion and fermentation, and until the year 1739, when records show the first distillation of coal by the Rev. Dr. John Clayton, nothing was known of the production of coal gas or its possibilities.

In the year 1792, William Murdoch, at Reduth, in Cornwall, manufactured artificial gas from the distillation of coal

in an iron retort, and lighted his house and offices. He followed this by lighting Boulton and Watt's shops at Soho near Birmingham in 1798 and gave a public display at Soho in 1802. In the meantime, Philippe Lebon in France, had lighted his house in the year 1801 and from then on many experimenters were working on this problem.

It was not until 1812, however, that the first gas company was formed. At that time, a charter was granted the London and Westminister Gas Light and Coke Company, and the growth and development of the gas industry dates from this time. America's first gas company was incorporated at Baltimore, Md., in 1816, and the development is clearly shown by the establishing of gas companies at Boston, Mass., in 1823, New York in 1823, and by the advent of gas lighting, the first use made of artificial gas, in the larger cities, Baltimore, 1816; New York, 1823; Boston, 1828; Philadelphia and Pittsburgh, 1836; Cincinnati, 1840; St. Louis, 1846; Chicago, 1850 and San Francisco, 1854.

Gas Service.

Any commodity whose use is so general that it can be said to be universal, becomes a necessity and, therefore, a public utility.

With the manufacture and distribution in every city and town of any size in the United States of gas, a universally useful and all important element of every day life in every home and in every one of the varying industries, this commodity, therefore, becomes a public utility, and the question of service rendered the public, the consumers, in point of continuity and character, naturally becomes one of prime importance. No matter how useful, economical, efficient or convenient a public utility is, no matter at what low cost it can be procured by the consumer, unless he can always be assured of the delivery of any quantity of such an agent at any time that he may desire it, and unless he can be assured of the maintenance of the quality of the agent when delivered, he cannot deem the agent one worthy of his careful consideration

as a part of the modern age of efficiency. If, however, such a product is placed at his disposal which embodies all of the qualities cited above,—the modern conception of service,—and if such a product also embodies the characteristics of economy, efficiency and convenience, this agent, whatever it may be, must be classed as a necessity of modern home, commercial and industrial life.

We have such an agent in manufactured illuminating gas. Let us see how it fulfills these essentials: In order to supply, without possibility of failure any demand as to quantity of gas needed at any time, the gas industry has an overwhelming advantage over any of its competitors. Unlike the electrical central station, the gas manufacturing station is not obliged to throw in additional manufacturing apparatus at practically the exact time that sudden or increased demands are made upon it. The gas plant has, by means of the gas holder, a large space in which to store its product during periods of low demand and against the periods of usual peak load or unusual and unexpected peak load. By means of these large storages of reserve supply, therefore, the consumer is always guaranteed absolutely against failure of supply at any time.

Further to insure the consumer, the systems of pipes and mains, supplying the various districts from their various holder stations and manufacturing plants, are so interconnected and cross connected in the distribution system of all modern cities, that should anything unforeseen happen either to the holders or to the manufacturing plant supplying any district, thus endangering the continuity of supply to that district, any one of the surrounding holder stations and manufacturing plants could be quickly connected to the district so threatened, instantly relieving any trouble. With this in view, the storage capacity of the holder stations of any district are designed and kept well in excess of the maximum demand of the district which they directly supply.

Furthermore, the reliability of supply of any manufactured product will be directly affected by any break down or acci-

dental disablement of the manufacturing apparatus. Any commodity delivered directly from the manufacturing machinery to the consumer depends for its continuity of service on the reliability of this manufacturing machinery. Therefore, in the case of the electric central station, dependence primarily must be placed on the generating apparatus,—a prime mover, steam engine, steam turbine, water turbine, etc., connected to and mechanically turning over the electric generator. All machinery made up of moving parts is subject to many mechanical troubles, no matter how carefully designed and how carefully operated and maintained. When we compare this condition with that found in the gas manufacturing plant, we find this process carried on with apparatus far more simple and far less liable to mechanical troubles. This adds one more assurance to the consumer of the absolute reliability of the gas service rendered by the modern gas company.

In proof of this we find that since the first introduction of gas in the United States in 1816, at Baltimore, Md., a general interruption of the gas service in any locality has been almost unheard of. This applies even to the period of the great Baltimore fire, when the gas service to Baltimore remained practically unaffected. In New York City, since gas was first introduced in 1823, in Boston since gas was first used in 1828,* in Philadelphia since gas was first used in 1836, and in Pittsburgh in the same year, and in all the other cities a single general or wide-spread interruption of the gas service up to the present time has never been known to have occurred. This proves beyond any doubt, the absolute dependability of gas as a public utility in so far as continuity of supply is concerned.

As previously stated, however, service includes not only constant and dependable quantity of supply but also dependable quality of supply. This means calorific power, candle-

* During the great fire in Boston in 1872, the gas supply to the city proper was interrupted for several days. In this great catastrophe, when every industry was at a standstill, the Committee finds the only exception to the general statement made above.

power, purity and pressure. Gas, as previously stated, is rated as a public utility, further borne out by the fact that of the entire number of cities in the United States having 25,000 or more inhabitants, 229 in number, from the census of 1910, every one has a gas supply, 208 having artificial gas and 21 having natural gas. The modern public utility corporation voluntarily renders service of the highest order, for such service is inherently a characteristic of successful business enterprise. This fact is generally understood by the public at large, but if further assurance of the protection of the interests of the consumer is required, it is found in the fact that where the public utility is operated by private interests, as in 227 of the 229 cases cited, the quality of the utility furnished is controlled or regulated independently of the operating interests in all but 18 cases. This is generally either state or municipal control and is always carried out by means of tests made periodically by the controlling state or municipal officials, with penalties attached for failure to fulfill these regulations. This power of control exists in 205 of the 229 cities, 130 having state control only, 34 having municipal control only and 41 having both state and municipal control. In the remaining 24 cities, ordinances are pending in four, the plants are municipally operated in two and in only 18 is there no power of control provided for.

Taking 76 of these cities having either state control, municipal control or both, and analyzing the scope of these requirements we find the calorific requirement varying from a minimum of 500 B. t. u.'s per cu. ft. to a maximum of 633 B. t. u.'s per cu. ft.—the candle-power varying from a minimum of 14 (in one case only) to a maximum of 23—chemical purity, varying on the four requirements of hydrogen sulphide content, sulphur content, ammonia content and carbon monoxide content; hydrogen sulphide total absence; sulphur from a minimum of 15 grains per 100 cu. ft. to a maximum of 30 grains per 100 cu. ft.; ammonia content from a minimum of 2.5 grains per 100 cu. ft. to a maximum of 10 grains

per 100 cu. ft., carbon monoxide content from a minimum of 25 per cent. to a maximum of 35 per cent.—the pressure requirement varying from a minimum of 1.5 inches to a maximum of 9 inches. These requirements are controlled as follows: 33 cities have calorific requirements, 55 have candle-power requirements, 30 have purity requirements, 31 have pressure requirements, 54 require meter accuracy varying from allowed range of variation of ± 1 per cent. to ± 3 per cent. and 52 cities have official inspection. Twenty-eight have both calorific and candle-power and purity requirements, 17 have calorific, candle-power, purity and pressure requirements, 15 have calorific, candle-power, purity, pressure and meter accuracy requirements and 14 have the entire range, calorific, candle-power, purity, pressure and meter accuracy requirements coupled with official inspections. In the appendix, Sec. "A," will be found as an example of quality constancy, gas pressure charts taken on the 12th floor of a modern office building during actual operation of the gas system. These charts show the absolute conformity of gas pressure conditions that are found in a modern building piped for gas.

From the above figures, which have been taken from the published investigation of the Bureau of Standards, at Washington, D. C., from the character of the process of manufacture and the provisions of storage and methods of distribution and from the records of performance, all as stated before, it is an undisputable fact that the gas companies are prepared to give and are giving the most perfect service, in the most modern conception of this word, that human ingenuity can devise.

With service of such character available, the constant quantity and reliability of supply and the constant and uniform quality of supply assured; the advantages to the owners of large buildings, in piping such structures for gas, are more than ever apparent.

The Modern Age and the Modern Building.

The present age has been aptly called the "Age of Effi-

ciency." Industry and commerce have devoted a large part of their time and energy to the purpose of increasing the efficiency of operation in the shop, in the stock room and in the office. Every separate phase of the work has been given special attention and much time, labor and money has been expended in the search and testing out of labor and money saving devices, appliances and agents. The engineers, on the other hand, have been continually working to the purpose of perfecting and developing present means to this end, of discovering and applying new means for this work, and of delivering them to the commercial world.

Does it not directly follow that the immense buildings which house these modern industrial enterprises should be made as modern and efficient as possible? Unless they are, does not this very fact tend to introduce an element which may defeat this struggle for efficiency and economy by making it impossible to utilize means and agents which are pre-eminent in these qualifications? Of what use can the efforts of the present day engineers be if the modern building through the persons directly connected with its erection,—the architects, builders and owners,—is not equipped with the means of utilizing all the advances of modern times?

Since this is a question of pure economics, the only reason that can be attributed for the omission of the means of utilizing any modern, efficient source of energy, on the part of the architect, builder or owner, is that of lack of information regarding the advantages and applications of the omitted agent. The only reason that can be attributed for his ignorance in this special case, is the lack of instruction and information offered him by the gas industry.

Modern building principles call for the most permanent of structures, so permanent in fact that it is undeniable but that they will outlast by many years the present generations. Due to this long life, the character of the occupancy and the uses to which the premises are put may change many times from those for which it was originally intended. This is a well

known fact, for in recent years in almost all cities we have seen not only single buildings completely change their character of occupancy, but whole neighborhoods change carrying with it a change in every commercial building in that locality. Again, present times see many and increasing industries and professions housed in business edifices. As examples, doctors and dentists are now becoming tenants of buildings originally erected for business offices, chemists and jewelers are occupying buildings erected for office or loft purposes, laboratories of all kinds are entering into this class of building, and many instances are recorded of clubs and large restaurants locating on the upper floors of office and loft buildings. Due to this variable condition of tenancy, and considering the probable entire change of occupancy, no building can be considered modern, complete or capable of answering all demands that can be made upon it unless it is so constructed as to make possible the use of all efficient sources of energy in the lighting, fuel and power fields.

As a purely financial investment, it cannot be denied that the more complete the service that can be offered, the more valuable as a rental proposition the building will become. A striking instance of this is in the Cloak and Suit Trades where by reason of the fact that in some cases buildings have been erected without proper provision for a gas supply, the tenants are compelled to use pressing irons heated either by coal or electricity, and to suffer the inconvenience and greater expense that the use of such fuels entail, when compared with the economy, safety and satisfaction of gas fuel for this purpose.

Cases of this sort are not unusual. Another instance may be cited where a very large concern had practically completed negotiations for space in a recently erected large building in one of the principal cities. Before taking possession it was discovered that there was no supply of gas and the tenant refused to move into the building unless gas was supplied him. The owner then put in the necessary gas piping at considerable difficulty and a cost far in excess of what it would have been

if installed when the building was erected. Cases similar to the above might just as readily have occurred, and doubtless frequently do take place in many other trades and industries of which the following are taken as examples:

Manufacturing jewelers, as a rule, locate in buildings of the type we are considering, and a supply of gas for their melting, crucible, case hardening, plating and refining, furnaces, soldering tools, blow torches, and lacquer drying ovens should be provided. Glass workers and glass blowers, especially the smaller concerns, require gas for their bench forges, blow torches, annealing furnaces and other uses.

Laboratories of all kinds have use for bunsen burners, stills, crucible furnaces, drying ovens, blow torches, sterilizers and a host of special appliances in which gas is pre-eminently the desirable fuel. All light metal work requires gas heated appliances such as a soldering iron or soldering iron heaters, tinning furnaces, die heaters, japanning ovens, etc. Photographers, tailors, barbers, hatters, china decorators, printing offices and electrotypers, assay works, automobile, bicycle and tin shops, badge and suspender makers, leather dealers and embossers, bookbinders and paper rulers, boiler tank and machinery manufacturers, carriage and wagon builders, florists and artificial flower manufacturers, bakeries, confectioneries, barrel, keg and wooden box manufacturers, bottling establishments, implement and tool manufacturers, iron and brass workers, wood workers and furniture manufacturers, canners and foodstuff manufacturers, cabinet makers, can and tinware manufacturers, chemists, chemical manufacturers and manufacturing druggists, porcelain makers, cigar and cigarette factories, tobacco dealers, cleaners and dyers, pottery manufacturers, paint, oil and varnish manufacturers, manufacturers of electrical equipment, engine builders, laundries, watchmakers, engravers, and die sinkers, cutlery manufacturers, clothing, shirtwaist and underwear manufacturers and corset manufacturers are but a few of the many trades from which the owners of large buildings may expect to draw

tenants who are dependent on gas for fuel or who at least would prefer to use it, if it were available.

Likewise the office or public building has its demand for gas for heating, refrigeration, power, waste disposal, hot water heating, etc., and in such buildings there is always the possibility of one or more kitchens for the feeding of employees or for public restaurants. For all of these uses gas burning appliances are available, and provision for them should be made, else the building is not a complete and an efficient unit. Unless, therefore, the building is piped throughout on erection, this lack of provision may become a serious handicap in so far as the rental feature is concerned and may become a cause of loss of revenue.

Gas as an Illuminant.

Unless gas equals at least in all respects the other forms of commercial illuminants, it would be inadvisable to pipe buildings for the lighting service. However, as a lighting agent, gas stands second to none and in fact has many points of advantage not possessed by its competitors. In fact, the criticism that has often been made of modern gas lighting is that unless the observer was previously informed he could not tell whether the lighting units were gas or electric. This in a way is true. With the latest developments in both inverted and upright incandescent mantle burners, gas can be applied to all forms of illumination, direct, semi-indirect, or indirect, with a resulting appearance exactly similar to the electric installations. These units, made in several sizes, giving a light from the smallest intensity commercially used to a light of as high intensity as needed for any indoor work, with the great variety of glassware which it is possible to use, are made up in fixtures varying from the plain, simple inornate fixture suitable for purely commercial lighting, to the rich, heavily ornamented fixture for use in the handsomest surroundings. This is not only true of the direct lighting units but especially true of the semi-indirect units where we find gas peculiarly adapted for use with the large variety of beautiful glassware that has been

developed for this system of illumination. This attractiveness applies equally well to the numberless portable lamps with their rich shades of many styles and designs, suitable for the living room, library, bedroom, den or boudoir.

Illustrations of a few of the different types of these units and varying classes of installations, which will be found in the appendix, Sec. "B" and "C" respectively, are conclusive proof of the statement made above that gas, in its application to illumination, lends itself equally well to any form or system in which electricity is used and can be rendered as artistic, decorative and pleasing to the eye as its electric competitor. The prices of these fixtures, which will be found accompanying certain of the illustrations, are those given by fixture manufacturers, for both gas and electric units of the same design, show that as far as cost is concerned, there is no difference between the two.

Directly connected with the consideration of appearance, comes the question of flexibility. Gas units are now placed on the market in varying sizes: for example, we have the inverted single incandescent mantle lamp in the following sizes:

Gas consumption cu. ft. per hour		Maximum candle-power	
About	2.00	About	40.0
About	3.00	About	60.0
About	3.75	About	80.0
About	10.00	About	250.0

The single, upright incandescent mantle burners in the following varying sizes:

Gas consumption cu. ft. per hour		Maximum candle-power	
About	1.60	About	32.0
About	3.70	About	70.0
About	4.50	About	90.0

In addition to these, we have the single, two, three, four and five mantle horizontal burners, especially adapted for semi-indirect work, using both large and small mantles giving the following sizes of units, a wide enough range to embrace any class of work met with in practice:

Burner	Consumption cu. ft. per hour	Maximum candle-power
1 light small mantle	About.... 2.00	About.... 60.0
1 light large mantle	About.... 3.00	About.... 90.0
2 light small mantle	About.... 4.00	About.... 120.0
3 light small mantle	About.... 6.00	About.... 180.0
2 light large mantle	About.... 6.00	About.... 180.0
4 light small mantle	About.... 8.00	About.... 240.0
3 light large mantle	About.... 9.00	About.... 270.0
5 light small mantle	About.... 10.00	About.... 300.0
4 light large mantle	About.... 12.00	About.... 360.0
5 light large mantle	About.... 15.00	About.... 450.0

This horizontal burner is designed so that the same burner can be adapted for either large or small mantles by simply changing the burner nozzle, an operation of the simplest kind requiring no more time or labor than replacing one electric bulb with another. This interchangeability insures perfect flexibility.

For higher powered units there are the low pressure multiple mantle units and the high pressure units. These can be obtained in sizes varying from 300 candle-power to 5,000 candle-power. Therefore, in so far as multiple sizes of units are concerned, we find gas unqualifiedly as flexible as any other commercial illuminant. In so far as flexibility of application, the illustrations show gas to be readily adaptable to any form or system of illumination met with in practice.

Allied closely with this question of flexibility comes that of control of the units themselves. This means the method of lighting and extinguishing. Before the advent of the incandescent mantle light, gas lighting usually required the use of matches and the manual lighting of each and every lamp. Simultaneously with the development of the mantle unit, however, came the invention of several methods for lighting and extinguishing lamps, and several methods of control, from a distance, until at the present time no installation can lay any claim to being modern or complete that requires the use of matches for ignition. We now have available these distance-control systems, and also local control, with single pendant switch or chain, similar in all respects to the electric local

control. Here the ignition is accomplished by a pilot light. This system has been in operation for many years and gives entire satisfaction.

From the many distance-control systems available, there are several which have been used in actual service and have proved reliable and dependable. These are the magnet cock with pilot ignition, the magnet cock with jump spark ignition, a system using the gas pressure for control and igniting by pilot light, and the hot wire, or filament, ignition in combination with the magnet cock. In actual operation in various installations these have given satisfactory service. Gas, therefore, has all the features of convenience of any of the commercial illuminants.

In the appendix, Sec. "D", will be found a short description of each of these systems with diagrams indicating their method of operation.

Modern gas illumination in point of reliability stands far above its competitors. This is due to three main causes: First, as has been shown, the supply of energy for this means of illumination has proven to be absolutely reliable. Second, due to the principle of construction of the incandescent mantle unit, if the mantle is broken, for some cause or other, unless it is completely dismembered, the unit will still emit light, while in the case of the incandescent electric bulb for example, if the filament is broken the bulb becomes totally worthless as a light producer. Third, the source of energy supply is not affected, causing interruptions of service, by any external conditions, such as heavy thundershowers or wind storms which at times temporarily cripple the electric installation where outside wires are carried overhead. Nor is it subject to interruption due to short circuits, a common cause in the case of electricity.

In so far as quality of light produced by the modern gas lighting unit, exhaustive tests by Dr. H. E. Ives, an eminent authority on this work, show that the incandescent mantle burner produces the nearest approach to daylight of all the

commercially used units. Again, Dr. Samuel Rideal, D. Sc., F. I. C., F. C. S., in his tests found as follows:

"(a) The sensitiveness of the eye to light as measured in the perception test, diminished very markedly after exposure to the electric light, while no corresponding effect is noticeable after the eye has been subjected to gas light."

"(b) The power of co-ordinating and using the motor muscles of the eyeballs recorded in the obicular muscle tests was diminished to a greater extent after subjection to electric than to gas light."

"(c) It was found that the ciliary muscles of the eyes are more accommodative after three hours exposure to the 50 candle-power light from the Darwin incandescent mantle than after a similar exposure to a 50 candle-power electric light."

"(d) The acuity of vision measured by the retinal test again shows that the optic nerve or center was more susceptible in the case of gas illumination. It will be seen that all the results point strongly in the same direction; namely: that gas light as used in those experiments is less fatiguing to the eye than electric light."

Ultra-violet rays are particularly injurious to the eyes and gas lighting is freer from them than any other form of artificial illuminant. In view of this, and the results of Dr. Rideal's opthalmic experiments, the argument for gas illumination is very strong.

The consideration of safety in lighting installations adds another point in favor of gas lighting. Electric light wiring is one of the fire hazards encountered in modern building construction because of the danger from defective insulation. This is a danger wholly absent from modern gas piping.

The assertion that gas lighting vitiates the atmosphere is one that has been given much credence by architects, builders, owners and in short by the general public, not because they

wish to condemn gas for illumination, but because they have been mistakenly led to believe that the use of gas produces an alteration of the atmosphere that is harmful. The basis of condemnation is that gas requires oxygen to support its combustion, and in burning gives off a large amount of heat and carbon dioxide. It is claimed that the large amount of heat is objectionable because it increases the temperature and dries the air; that since the combustion of gas produces carbon dioxide its use will soon render the atmosphere impure hygienically, and that because gas consumes oxygen in burning it deprives the air of a quantity sufficient to render it unfit to maintain health.

It is very true that oxygen is necessary to support combustion and that carbon dioxide and heat result from this combustion of gas, but does this statement justify the condemnation of gas lighting? To what extent is oxygen reduced, what alterations in temperature and humidity occur, how great is the increase in the carbon dioxide content of the air? These are the questions that should naturally arise—on the answers depending largely the advisability of using gas for illumination. On this hygienic consideration your committee feels that a strong educational effort is required embracing a plain statement and proof of the facts, for it believes that this false impression which is so deeply rooted in the public's mind, is one of the greatest handicaps to the utilization of gas for illumination, and therefore, a handicap to one important argument for the piping of large buildings for gas.

Eminent authorities such as Dr. Samuel Rideal, D. Sc., F. I. C., Dr. Leonard Hill, M. B., F. R. S., Dr. F. S. Toogood, Dr. Max Joseph von Pettenkoffer, Lord John Haldane, Dr. Otto Hehner and Sir Edwin Ray Lankester, have made exhaustive researches on these questions and upon their findings your committee bases its argument.

In some of the worst ventilated habitable rooms, where the supply of fresh air is limited to that finding its way in through windows, cracks, under doors, etc., the oxygen content has

been found to be not less than 17.6 per cent., a greater diminition being prevented by ventilation or diffusion through the minute pores of the walls and ceilings and around the doors and window frames. Since, under such extreme conditions, the greatest reduction of oxygen content that can take place, due to the burning of gas for illumination, is only 1.5 per cent., bringing the content from 20.7 per cent. (the normal oxygen content of the atmosphere) down to 19.2 per cent., the fallacy of this argument is apparent.

Experiments made comparing the humidity effect of electric lighting, a source taking nothing away, nor adding anything to the atmosphere, and gas lighting have proved that the illuminant has but little effect in this direction. Actual tests show that while water vapor is contributed to the air during the combustion of gas, the net quantity of water vapor remains practically the same as it is with electric lights. The fact is that the influence of gas or electric lighting upon humidity is so small that neither illuminant seems to effect the saturation of the atmosphere one way or the other.

Dr. Rideal's experiments on two identical rooms one lighted with electricity and the other with gas, gave the following results as to temperature obtained in the rooms:

	Gas				Electric			
		Degrees F.				Degrees F.		
Room condition	No. Runs	Initial	Final	Rise	No. Runs	Initial	Final	Rise
Restricted ventilation ...	22	53.6	57.0	3.4	18	54.0	57.2	3.2
Restricted ventilation ...	6	59.0	63.4	4.4	6	58.7	62.9	4.2
Fireplaces and ventilators open	2	60.8	63.9	3.1	2	59.2	62.7	3.5
Fireplaces, ventilators doors, windows open .	2	58.4	57.5	−0.9	2	58.3	56.9	−1.4

This shows that the rise of temperature caused by the two illuminants was practically the same, and that, although the gas furnished more heat than the electric lamps, the more active ventilation caused by this extra heat carrying the hot products of combustion to the ceiling where they are diffused

through the ceiling and side walls and cooled by coming in contact with these surfaces, and drawing in fresh air at the windows, doors, etc., fully compensates for the difference.

The sanitary limit for carbon dioxide has been placed at 6 parts per 10,000 of air. This limit is only correct when the source of pollution is respiration. When present to the extent of 6 parts in 10,000, the atmosphere will be noticeably fouled to one entering from the fresh air, but it must be remembered that this effect is due to the organic matter emanated from the skin and lungs during respiration and not to the slight excess of carbon dioxide.

Experiments by Dr. Samuel Rideal, Dr. Angus Smith, Dr. Pettenkoffer, Lord Haldane and others, have conclusively proved that very large quantities of carbon dioxide, when produced by combustion, have no bad effect upon the human system; as high as 225 parts per 10,000 have been found to produce no discomfort. Since, under the worst possible conditions of ventilation in a gas lighted room, the carbon dioxide content has never been found to be greater than 20 parts in 10,000 of air, it is evident that the use of gas as an illuminant is hygienically correct, in so far as the carbon dioxide produced.

The heat given off in the combustion of gas, causes a decided air movement in the gas lighted room, a requisite of hygienic atmospheric conditions. Heated air rapidly rises and for this reason the products of respiration of the occupants of a room, containing organic matter, moisture and in some cases bacteria, together with the products of combustion, are pulled to the ceiling, out of the breathing level by this uprush of air created by the heat of combustion. Again in passing to the ceiling, a large quantity of the air passes directly through the gas flame, which, with its temperature of about 1,500° F., incinerates and cremates any organic matter or bacteria, thus actually purifying the room's atmosphere. Experiments have shown the following:

ELECTRIC LIGHTING.

Organisms present		
At start of test	At end of test	No. persons in room during test
12	15	8
26	18	8

GAS LIGHTING.

Organisms present		
At start of test	At end of test	No. persons in room during test
4	0	8
6	0	9

Gas, therefore, when applied to illumination, not only has no harmful effect on the atmospheric conditions but actually becomes an agent of hygiene, increasing the ventilation, sterilizing the air and keeping the atmosphere at the breathing level pure and wholesome. This fact alone should cause careful consideration to be given gas as a source of illumination.

It is a well known fact that illumination can be produced with gas far more economically than with electricity, its closest commercial competitor. To substantiate this statement, charts and calculations are given in the appendix, Sec. "E," for a typical few of the many cases which it would be possible to cite.

Should not every large building be so constructed when erected as to make possible the securing of illumination from a source possessing every advantage in appearance, flexibility and ease of control, and one possessing pre-eminent advantages in reliability, safety, cost, quality of light furnished and hygienic effect?

GAS AS A FUEL.

In connection with the use of gas for fuel purposes, it may be stated as a fact that in very many cases where a new building has been erected and where the installation of a gas piping system was not included in the original plans, subsequent demands have made it necessary to provide for a gas supply.

Even though there was little prospect of a demand for gas for fuel or other heating operations at the time the building was projected, a change in the character of the occupancy or in the neighborhood in which the building is situated may be very readily, and in fact, has frequently been, found to make it imperative to provide the tenants with a convenient source of fuel.

Let us consider why tenants of modern buildings would and do demand gas fuel in their industries. First—because of its reliability, absolute assurance of continuity of quantity and quality of supply; second—due to its safety, no fire hazards due to faulty wiring with resulting short circuits, no danger due to shock from electric circuits, appliances specially designed to reduce the element of danger while in operation, and a source of energy that can instantly be shut off when not in actual use or when foreign conditions warrant; third—convenience, no lengthy preparation of a solid fuel fire but instant service upon turning on of the supply; fourth—cleanliness, no dirty fuel, to charge, no ashes or dust to remove and store temporarily for final removal, no smoke, no obnoxious odors; fifth—ease and exactness of control, either manual or automatic adjustment of operation by simple regulation of the supply with a precision of regulation making it possible to govern the temperature or heating operation within the closest limits; sixth—speed when in constant or intermittent use, no long wait as with other fuels until correct temperature conditions are obtained, no necessity of constant burning when in intermittent use; appliance always ready for starting at instant's notice; seventh—space economy, reduced size of appliances over those employing other fuels, saving of space required for storage of these fuels or temporary storage of ashes, etc.; eighth—labor economy, doing away with labor of securing, storing and charging other fuels and labor of removal of the products of combustion from them, eliminating labor necessary in continuous handling of fuel where other fuels are employed and use of appliance is intermittent;

ninth—operating economy, efficiency of appliances and efficiency and economy due to possible automatic control, fineness of adjustment and adaptability for intermittent work; tenth—lower rate of insurance possible to obtain; eleventh—ease of conveying gas, the fuel, to isolated points and ease of applying to portable apparatus thereby assuring a supply of energy for heating, etc., at any possible location, and twelfth—the ease of attaining high temperatures with accurately localized heat.

That gas is demanded by manufacturers is born out by actual experience in nearly every city and is clearly shown by the wide range of industrial installations shown in the illustrations in the appendix, Sec. "F." Space has necessarily limited these illustrations to a comparatively few of the many applications.

Since industries are locating on the upper floors of modern buildings where the actual obtaining, handling and storing of other fuels would be well nigh impossible or at best inconvenient and expensive and where the loss of floor space valuable as it is in the modern building, would be a severe financial loss, and since gas as a fuel possesses so many practical advantages, it is actually a grave error of omission practically to preclude the securing of these advantages by not installing a gas piping system in the commercial building when it is erected. This is especially true when we consider the great variety of processes and operations for which gas appliances are manufactured, a short list of which is given below, a fact which adds further proof to the statement that modern industry demands gas, for the appliance manufacturers would not construct appliances for which there was no market. A condensed list of these appliances is as follows:

Automatic water heaters	Annealing furnaces
Assay furnaces	Air tempering furnaces
Automatic hardening furnaces	Automatic heating machines
Ammonia tempering furnaces	Animal crematories

Broilers
Bake ovens
Bunsen burners
Brazing burners
Babbitt melting furnaces
Barium chloride furnaces
Barbers' boilers
Bung branding machines
Bottle dryers
Bottle washing machines

Bottle sterilizers
Boiling stoves
Blow torches
Branding and marking irons
Band shrinking furnaces
Bronzing furnaces
Barrel heaters
Barrel sterilizers
Body baking ovens
Bolt heaters

Clothes dryers
Crucible melting furnaces
Case hardening furnaces
Cyanide hardening furnaces
Confectioners' stoves
Coffee urns
Core drying ovens
Coffee roasters
China kilns
Collar and cuff shapers and folders

Cutlery forges
Clothes pressing machines
Cupelling furnaces
Carbonizing furnaces
Crimping machines
Chocolate melters
Cocoa bean roasters
Can cappers
Cauldrons
Conditioning ovens
Collar and cuff ironers

Dish warmers
Die heaters
Down draft furnaces

Drying ovens
Drug stills

Enamelling ovens

Embossing presses

Furnaces for annealing glass
Feather steamers
Fruit renovators

Forges
Fowl singers

Gas sad irons
Garage heaters
Gas signs

Galvanizing furnaces
Glue heaters

Hot air bath cabinets
Hardening furnaces
Hair dryers
Hog trimmers
Hat stamping machines
Heating machines
Hair singers
Hat band and badge presses

Ham boiling vats
Hatters' stoves
Hot tables
Heating tables
Incinerators
Ice cream cone bakers
Incubators
Ironing machines

Japanning ovens

Lard rendering stoves
Lead hardening furnaces
Laundry stoves
Ladle furnaces
Laundry mangles

Milk sterilizers
Mould drying ovens
Metal melters
Muffle furnaces
Ovens for baking motor armatures
Oven furnaces
Ovens for drying tobacco
Oil tempering furnaces
Ore roasters
Popcorn poppers
Paint burners
Peanut roasters
Pipe bending furnaces
Pickling furnaces
Paper dryers
Pyrography burners

Rim brazing furnaces
Rendering kettles
Refrigerating machines
Rosin melters
Rivet heaters
Refining furnaces
Soldering iron furnaces
Sand tempering furnaces
Steam bake ovens
Steam bath cabinets
Shoe burnishers
Steam jacketed kettles and cauldrons
Spoke brazing furnaces
Singeing burners
Seam dampeners and presses
Sweep reducing furnaces
Stock boilers
Steam boilers
Shirardizing ovens
Sugar boilers
Smelting furnaces
Soft metal melters
Smoke houses
Sausage smokers
Stamping irons
Salamanders
Sterilizers

Tube brazing furnaces
Tempering furnaces
Tire heaters
Tinning furnaces
Tool forges
Tailors' stoves

Vulcanizers
Varnish boilers

Water heaters
Wafer bakers
Water sterilizers
Wood drying ovens
Wax melters
Water stills
Warming ovens
Wood steamers
Water, tea and coffee urns
Washing machines

As has been previously stated, it is the tendency of modern times for various industries and professions to locate in the modern commercial building. This has become more and more the universal practice and it would be too lengthy a matter to attempt listing these cases since it would cover almost all

known industries, but reference to the illustrations of installations in the appendix is ample proof of this fact. Since these industries are large users of gas as a fuel, it must directly follow that they will locate in buildings which have a means of supplying their demand for gas. This, in itself, should be a sufficiently weighty argument for piping these buildings, but in addition when we consider the small number of outlets necessary for this class of work and therefore the extremely small amount of piping needed, the omission of this piping, which may become a serious obstacle to the revenue producing powers of the building, can only be accounted for by the lack of information and data on this subject on the part of the architect, builder and owner.

This fact is clearly brought out by the study of the use of gas for cooking as an example. In the preparation of food, whether for wholesale factory production, hotels, restaurants, clubs, institutions or lunch rooms, the use of gas is daily becoming more general. It has over its only competitor, coal, the advantages of actual economy in both operation and space, cleanliness, speed, ease of control and safety. The question of ashes, handling, etc., need not even be discussed. In large installations these advantages are of even greater import than in domestic installations where the use of gas has become universal. The piping required for this class of service consists of but a single line to the kitchen. If ample riser capacity is furnished when the building is erected, the kitchen may be placed wherever desired without further consideration of fuel supply. As an example may be cited the world's tallest building which is generously provided with gas risers and due to this fact alone they were able to secure as tenants on the 27th floor, a club which required facilities for an elaborate kitchen.

In the planning of buildings which are designed to house manufacturing concerns, failure to provide for a gas supply system is inexcusable. In industrial and manufacturing operations, such as the heat treatment of metals, the generation of steam in small or moderate quantities or for intermittent use,

the melting of soft metals, japanning lacquering and a host of other uses extending over a wide range of trades and applications, the pre-eminent position of gas as a fuel cannot be denied.

Gas As a Source of Power.

As a source of power the gas engine under favorable condition of uniform load is a most efficient prime mover, offering an economic, convenient and reliable source of power producer. That the gas engine is demanded in the industrial and commercial field is clearly shown by the record of one gas company in a large city in 1913. This company sold 189 gas engines which represented 45.2 per cent. of the power business bid on during that period. Here again the piping necessary is small in amount and therefore small in initial expense, while the advantage attained, through added rental value of the building is proportionately great.

Improvements in the Future.

It has been pointed out that the modern age witnesses the continual effort towards improvement of existing energy sources and their applications. This is true in so far as gas is concerned. The use of gas is constantly being extended to new applications and this development may be logically expected to continue indefinitely—certainly it is a grave error of omission to leave out of a new building so important a factor as the gas piping system, for by doing so it practically precludes the securing of these advantages.

As an example of this, room or space heating may be cited. For this work any of the systems now commonly used with all fuels is grossly inefficient. Development in the application of gas to space heating, by direct radiation, promises much, and this method which is admittedly the ideal one for space heating, is sufficiently advanced to warrant the belief that in time it will come into general use and such a possibility alone should have weight in planning the gas supply systems for new buildings at the time of erection, since the buildings

themselves are so permanent in character, as to assure an extremely long life, embracing an indefinite period of development and fulfilment.

Piping After Erection.

Having shown the necessity of completely piping large buildings for gas, for lighting, fuel and power requirements, and again emphasizing the fact that it can only be due to the lack of knowledge and information on the part of the architects, owners or builders, that this is not being done in every case, and emphasizing also, the fact that it remains for the gas industry to remedy this defect by strong energetic and concerted action, let us see what the cost of such piping is, if put in at the time the building is erected: This last phase of the question must be considered, for it has been found by experience that gas service is demanded by the tenants and, if the building is not equipped for such service, the owner must go to considerable expense of remedying this defect. One example of this sort has been cited earlier in this report but to emphasize this point the case of a large department store in one of the large cities will be mentioned. The owners, architects and builders of this store were advised and urged to pipe their building completely when erected. However, they thought this unnecessary, but within one year from the time of the completion of the building they found that they had made a mistake and it was necessary, at considerable expense and inconvenience, to install this gas piping. While the piping was run exposed on ceilings and walls, to avoid an excessive expenditure, the cost was far in excess of that which would have been necessary to install concealed piping during construction, and the exposed piping has marred the appearance of the building and has been more or less an eyesore to the management ever since; yet as a necessity it must remain.

Another large department store in the same city did not think it advisable to pipe the building throughout, although after a great deal of persuasion gas outlets were placed at all elevator and hall entrances and at the head of all moving

stairways. In order to reach these points, they were persuaded to continue the piping straight across the building and a few outlets were left on various floors in addition to the places above described. Although this company generates its own current and lights its own building, and although they thought they had safeguarded themselves in every way against having trouble with their lighting system, they had not been in their new building more than a few months before it was found, after all the precautions that had been taken, on several occasions their lighting system was out of commission. They realize to-day that the few gas outlets which they were practically forced to install have been of great service and the management feel that a serious mistake was made in not giving more thought to the placing of proper gas outlets.

Naturally, not only is this expense of piping after erection far greater than that necessary to pipe the building at the time of construction, but the difficulties met with, the inconvenience and troubles encountered make this a decidedly unsatisfactory condition to be treated.

Piping Necessary.

The committee realizes that a detailed table showing the size of risers, size of branch piping, number and size of fuel power and lighting outlets for various classes and size of buildings, and for various spaces in them would be a great aid to the gas manager in working out his problems. However, the compiling of such a table would involve so many variables and such a table would have to be in such great detail, in order to satisfactorily meet all conditions, and inasmuch as another paper to be read at this meeting will separately treat this subject of interior gas piping, it has been thought advisable to endeavor only to give a few general suggestions which it is believed can be followed with satisfactory results. For this purpose the space in large buildings has been divided into four main classes and the outlets necessary for each class given in a general way.

Classes of Space.

(1) Large areas in loft buildings used for storage or manufacturing purposes.

(2) Large rooms in public or office buildings used as assembly halls, court rooms, large offices and miscellaneous purposes.

(3) Rooms in office buildings used as offices.

(4) Rooms in hotels and apartments used as reception rooms, living rooms, bed-rooms, etc.

Outlets to be Installed.

(1) This is generally a case of exposed piping. Baseboard outlets (not less than 1¼ in.) should be installed at reasonable distances or to suit occupancy. Proper outlets should be installed for the lighting system.

(2) One ample baseboard outlet (not less than 1¼ in.) should be installed for any possible future supply for gaseous fuel. Proper outlets should be installed for the lighting system and modern attractive gas fixtures or combination gas and electric fixtures so designed that modern gas burners may be as easily and attractively used on them as may electric lights.

(3) Usually one baseboard outlet (not less than ¾ in.) should be installed for connection of portable light or possible use of gaseous fuel. One or more ceiling outlets for the lighting system with fixtures as outlined in (2).

(4) The larger rooms should be provided as in (2). The lighting system should also be as outlined in (2). The larger living rooms and bed-rooms should preferably have more than one baseboard outlet.

Cost of Piping.

The committee has analyzed the cost of piping many buildings brought to their attention, from the simple case of piping a loft building, where the number of outlets is few due to undivided space, and, therefore, the branch lines on each floor few in number—to the case of the complete piping of

large office buildings for lighting outlets, baseboard outlets, fuel and power requirements.

In the case of loft buildings, the following examples of cost of piping done when the building was erected will be cited, in each case the piping having been done by a licensed plumber giving figures that are authentic in every way for duplication.

Building nine stories high, 100 ft. x 400 ft. Two risers containing 90 ft. of 6 in., 80 ft. of 5 in., 50 ft. of 4 in., pipe and 25 ft. of 3 in. pipe, with branch piping on each floor. Total cost of piping $1,280.00. Total cost of building about $1,000,000.00. Cost of piping in per cent. of total cost of building is 0.128 per cent.

Building 10 stories high, 200 ft. x 106 ft. Four 3 in. risers run from the gas service to the roof and 2-3 in. risers from the basement to the fourth floor, containing 650 ft. of 3 in. pipe. Branch pipe was run on each floor for lighting and outlets left on the risers for fuel and power connections. Total cost of piping $3,300.00. Total cost of building about $600,000.00. Cost of piping in per cent. of total cost of building 0.55 per cent. This building has all gas lighting piping run exposed on hangers on concrete construction making the installation more expensive than if concealed piping was used.

In the case of office buildings, the following examples will be cited:

Building 18 stories high piped for emergency lighting and fuel requirements. Total cost of piping $2,100.00. Total cost of building about $1,000,000.00. Cost of piping in per cent. of total cost of building 0.21 per cent.

Building 12 stories high piped throughout for gas illumination with 119 outlets per floor or a total of 1,428 outlets. Total cost of piping $1,800.00—total cost of building $620,700.00. Cost of piping in per cent. of total cost of building 0.29 per cent.

Building 18 stories high 298 ft. x 84 ft. piped completely for gas lighting throughout, with baseboard outlets throughout, and with fuel outlets in basement and in pent houses on roof.

In this building there are two 4-in. risers from the basement to the 18th floor and one 3-in. to the 8th floor reduced from here to 2-in. to the roof of the pent houses, to supply the lighting and base board outlets, and one 4-in. riser from the basement to the roof to supply the appliances in the basement and the kitchen which is located in the pent house. This building contains 2,143 lighting outlets and 398 base board outlets. Total cost of piping $26,370.00 in per cent. of total cost of building not quite 1.0 per cent. This building involved the repairs to an old section with its old gas piping system, which was remodeled at the time of completion of the building and a considerable overtime charge for labor made necessary by these repairs. The percentage stated above therefore is actually greater than would apply to even the most elaborate new structure. This is a case of the most elaborate and comprehensive system of piping that could be put in a building of any class and supplies not only illumination, the requirements of a large restaurant and kitchen, but many other fuel and power uses as well.

From these typical, practical examples it can be seen that the gas piping installation in a modern building, if put in at the time of erection, amounts to an extremely small figure varying from 0.128 per cent. to 1.0 per cent. of the total cost of the structure for buildings varying from a loft building with its small number of outlets to the most elaborate piping of a modern office building.

In the appendix, Section "G," will be found piping plans of typical floors of modern loft and office buildings which come under the cost classification made above, and in Section "H" will be found illustrations of modern buildings piped for gas.

Conclusion.

The committee has endeavored to show conclusively that the modern commercial building should have every provision for the utilization of all agents in the lighting, fuel and power fields due to the modern trend toward efficiency, the permanent character of these buildings, the constant change in

occupancy and neighborhood, the ever increasing number of trades and professions becoming occupants of this class of building and the increased rental values obtainable due to this equipment. It has been shown that gas is such an agent and one that is universally demanded by a wide range of these industries and that in point of service, reliability of quantity and quality of supply, it is pre-eminent. In the lighting field it has shown gas to have many advantages in appearance, flexibility and ease of control, and to have pre-eminent advantages in reliability, safety, cost, quality of light and hygienic effect. As a fuel, gas has been shown to have absolute reliability, safety, convenience, cleanliness, ease and exactness of control, speed, space economy, labor economy, operating economy, insurance advantages and portability. Gas as a power agent has been shown to be demanded and to possess sterling qualities of merit. The improvements being made continually in all methods and agents have been shown to apply to gas equally well as to other sources of energy and finally the extremely small cost of piping a building at the time of erection has been proven and the necessity, the increased cost necessary and the inconveniences and troubles encountered of piping after erection have been brought out.

Nevertheless, it is a fact that the too general practice at the present time is to erect the modern large building without making any provision for the utilization of gas as a source of light, fuel and power. This lamentable condition can only be due to the lack of information on the part of the architect, owner or builder of the many advantages of gas as an agent for light, fuel and power as well as the failure to have properly emphasized the considerable financial expenditure and inconvenieces necessary to remedy this defect after the building is completed. If this is truly the case, and your committee firmly believes it to be so, the cause of this elimination of gas piping lies directly at the door of the gas industry. This means that the gas companies at the present time are losing a large field, with its possibilities of large gas consumption, and

are in grave danger of materially restricting the utilization of gas and of permanently losing this field.

Your committee feels that this situation is serious enough to warrant immediate action. However any such action should be concerted, energetic and above all carefully planned. It might best be the object of a well conceived continuous campaign, and such will be the definite recommendation of this committee. It must be remembered, however, that in making this recommendation, the committee has only endeavored to give a general outline of the course of procedure, and it is understood that various gas companies may find it possible to adopt only a portion thereof or may make modifications found necessary by local conditions that have to be met. Therefore, no attempt has been made to lay out any details, it being considered wisest to leave these entirely in the hands of each gas company.

The parties vitally interested in this work are the owners, architects, builders and plumbing contractors, and they are the ones that the gas interests must reach. For this purpose, your committee would recommend the following:

Recommendations.

1.—Newspaper, architectural and building magazine and street car advertising giving in a compact, explicit and attractive form the arguments for piping large buildings for gas. These advertisements would reach the architects, builders and owners in a general way and attract their attention and should contain the offer of free expert advice in piping and installation work by the gas company.

2.—The maintenance of a staff of engineers or men capable of giving this information to the architects, builders and owners.

3.—The circularizing of all architects with an attractive booklet showing the many uses of gas in all fields, similar to the "Gas Equipment of the Home," issued by the N. C. G. A.

This should be gotten up in an attractive manner and with an appearance that would make certain of its being read and not thrown away on receipt. It would be well to enclose in this booklet a pamphlet giving concise reasons for piping large buildings for gas and offering again free service of experts of the gas company.

4.—The maintenance of a staff of men whose sole duty is to visit architects, owners and builders of new buildings in an attempt to interest them in the gas piping of the same. These men should be in close touch with all new building operations, both contemplated and under course of construction. This can be accomplished by using any of the various building report agencies who prepare reports on all building operations, giving location, owner, architect, contractors, class of building, etc., and progress of work. The Dodge Report System is typical of this work. These men should be sufficiently informed on the advantages of gas in all its uses and the cost and method of piping buildings to be able to talk intelligently and convincingly on these points. It would be well also if these men were closely connected personally with the building and architectural world.

5.—The education or influencing of the plumbing and contracting fraternity by circularizing, personal interviewing or general educational work, in an effort to induce them to recommend adequate gas piping in all cases. This seems to your committee to be a very profitable field and one that will undoubtedly produce productive results since the plumber and contractor should easily be convinced of the need for gas piping in large buildings and easily induced to lend their aid with the architects, because it is to their personal interest to secure as much work as possible in all building construction. Your committee further believes that the plumbing and contracting profession once on the side of gas piping can lend considerable weight in presenting the case to the architect and builder.

6.—The use of a careful and intelligent follow up system in all this work.

The Committee desires to express its appreciation to Mr. Thomas Scofield, of New York, and Mr. G. S. Barrows, of Philadelphia, for the assistance that they have given in the preparation of this report.

Respectfully submitted,

OSCAR H. FOGG, *Chairman,*
WM. J. SERRILL,
R. E. SLADE,
JAMES MCILHENNY,
CARROLL MILLER,
Committee on Piping Large Buildings for Gas.

APPENDIX.

SEC. A.—PRESSURE CHARTS.

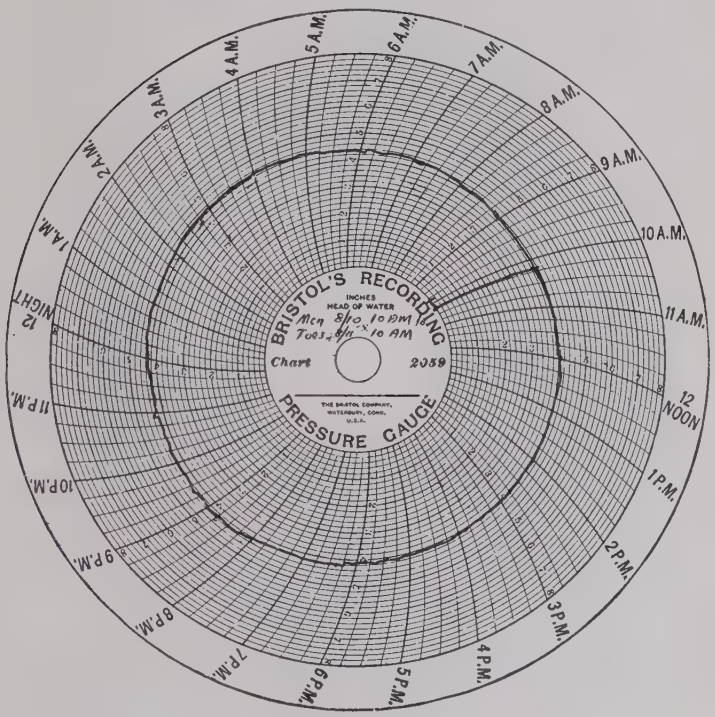


Chart No. 1.

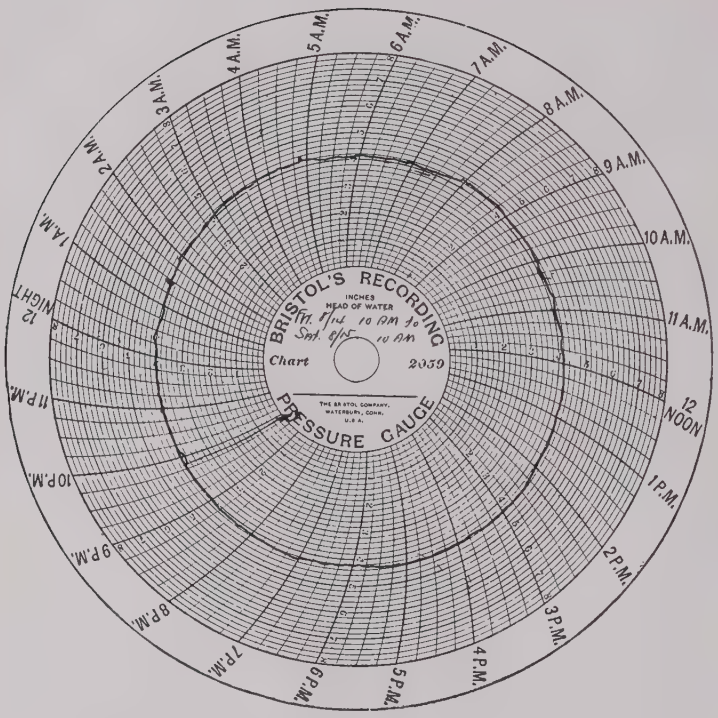


Chart No. 2.

Sec. B.—Fixture Illustrations.

Index.

Class of fixture	Illustration No.
Direct lighting side brackets	1–6
Direct lighting ceiling fixtures	7–18
Semi-indirect lighting side brackets	19–20
Domes	21–22
Portables	23–26
Semi-indirect lighting ceiling fixtures	27–30

Note: Illustrations Nos. 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 23 and 25 by courtesy of the National Commercial Gas Association.

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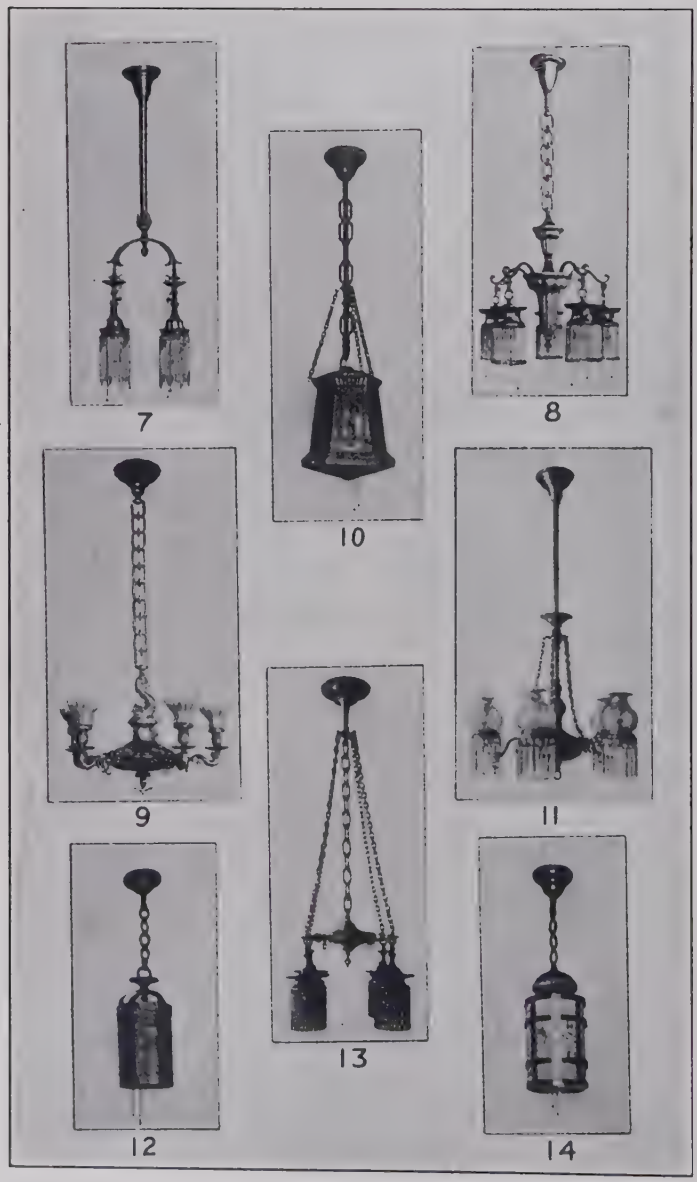
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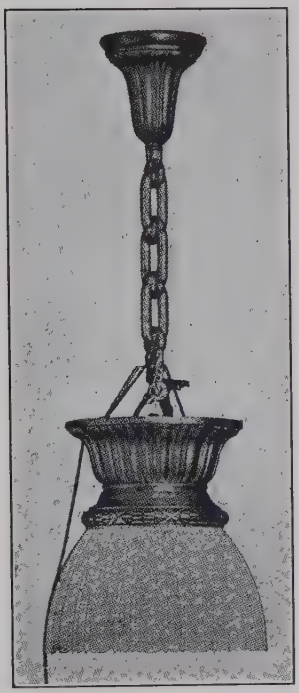

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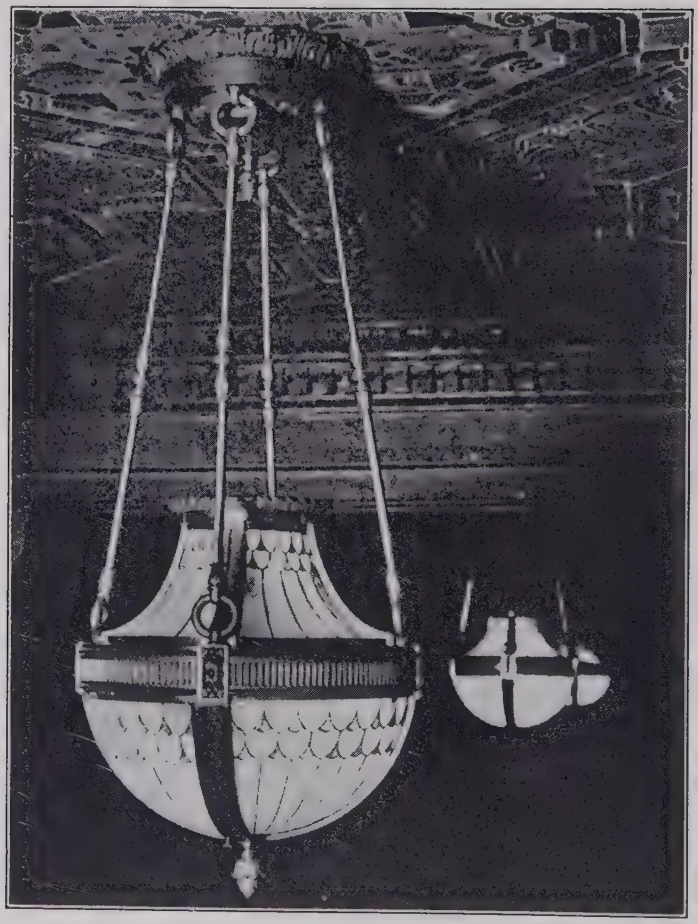

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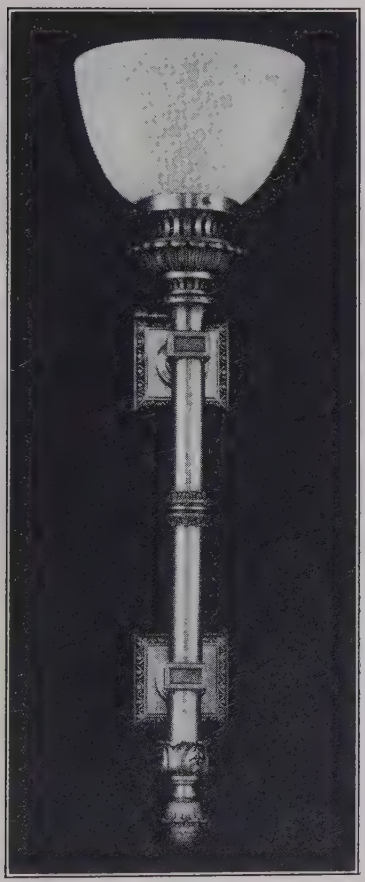

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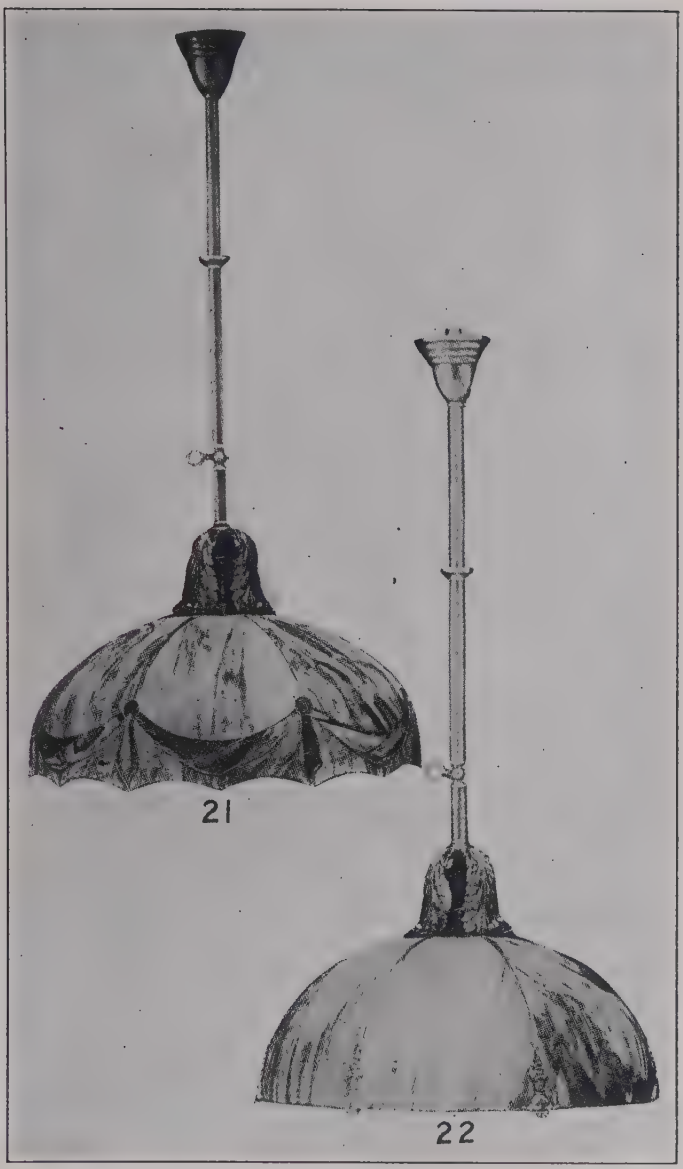
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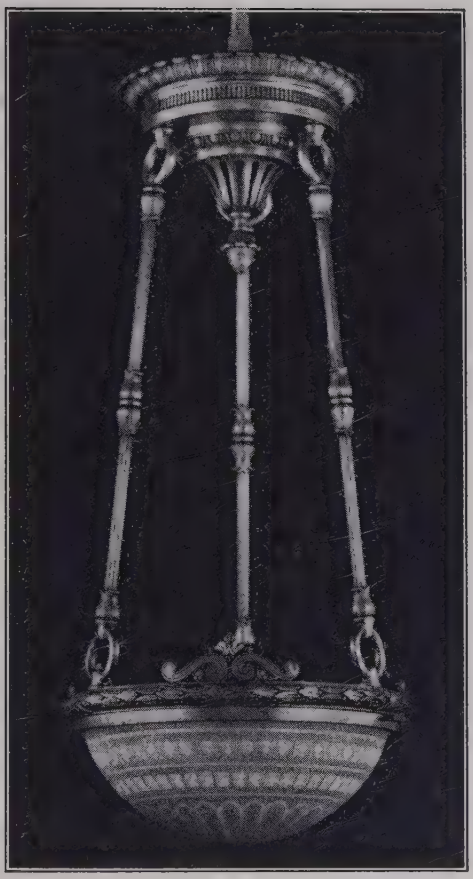

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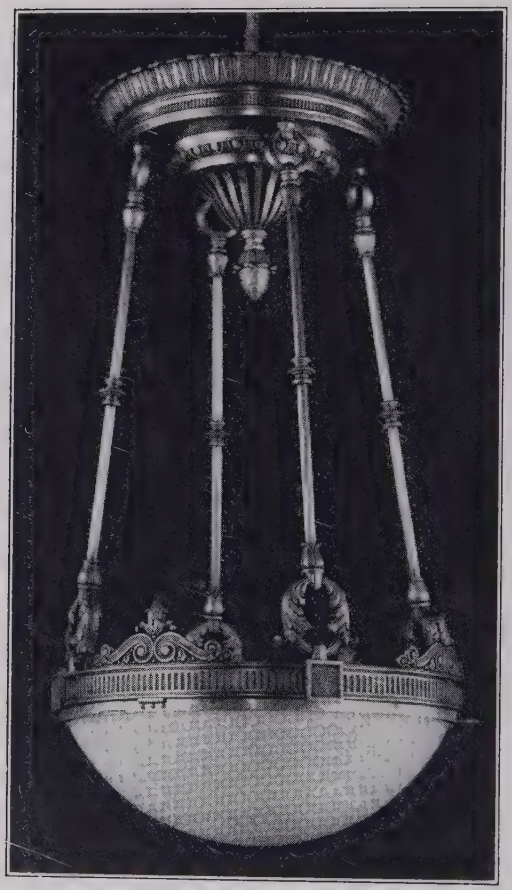

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Sec. C.—Lighting Installation Illustrations.

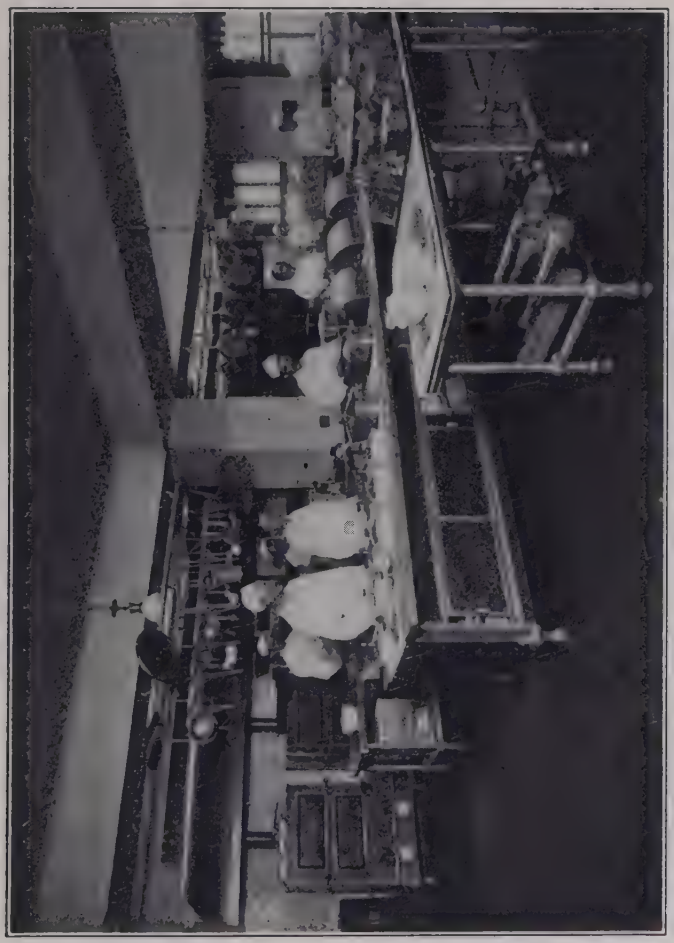
Index.

Class of installation	Illustration No.
Direct lighting (commercial)	1–9
Direct lighting (domestic)	10–18
Semi-indirect lighting (commercial)	19–26
Semi-indirect lighting (domestic)	27–35

Note: Illustrations Nos. 17, 18 and 32 by courtesy of the National Commercial Gas Association.

No. 1.

No. 2.



No. 3.

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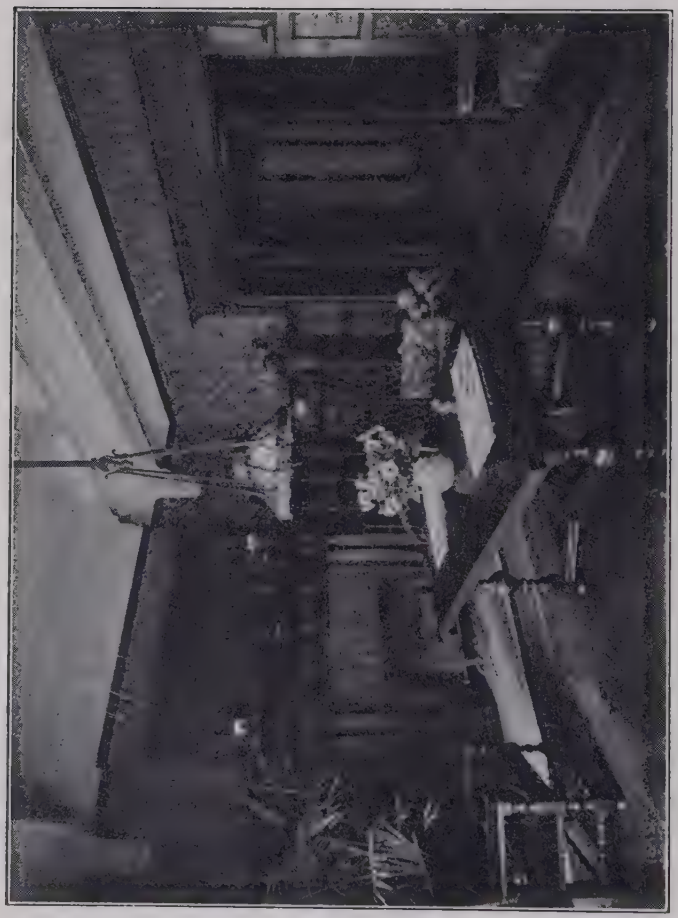
No. 11.



No. 12.

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No. 21.

No. 25.

No. 27.

No. 28.

No. 29.

No. 30.

No. 31.

No. 32.

No. 33.

No. 34.

No. 35.

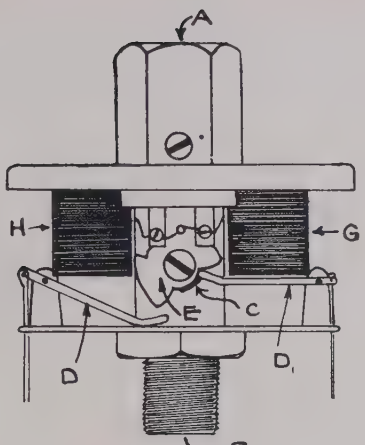
Sec. D.—System of Control.

Magnet Cock.

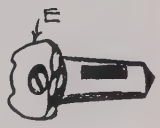
This is shown in Figs. 1 to 3. Fig. 1 shows one elevation, while the other elevation is shown in Fig. 3. This valve is placed in the piping at the ceiling and is operated from some convenient point, turning on and off the gas to the light. The gas is ignited by means of a pilot light. By pushing the "on" button of the switch F, the circuits on the "on" set of coils G, which consists of two small coils connected in series, is closed. These coils, when energized, attract the armature D, which carries a cam follower which operates the cam E, rotating the valve shown in Fig. 2. This opens the passage and the gas flows to the light where it is ignited by the pilot light. The "off" button operates the two electro-magnets on the opposite side, and rotates the valve in the opposite direction, closing the gas from the mantle. The valves have to be oiled once in a long time and the batteries renewed at varying intervals, depending on the number of times the lights are turned on and off. In general, they have been found to give very little trouble. The action is practically instantaneous. From tests made on them, it was found that the current necessary to operate one valve was 1 amp. at 400 lts., while it was found that they operated with more satisfaction on 2 amp. and 700 lts.

Jump Spark System.

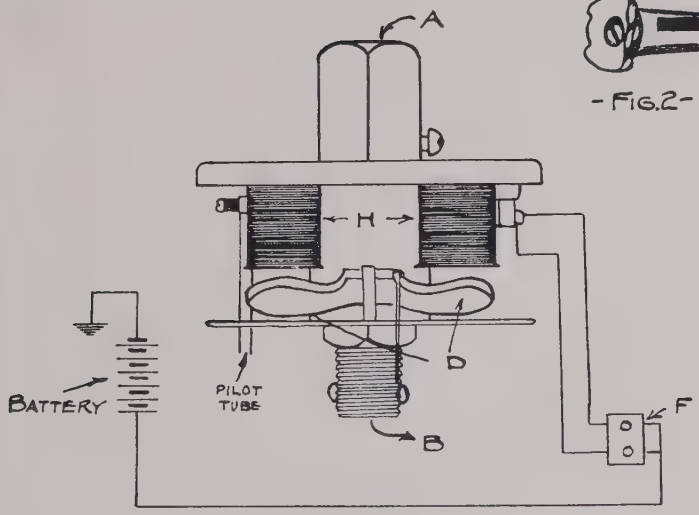
This is simply a system of ignition, and the gas must be turned on by some other means. It is shown in Figs. 4 and 5. The sparkers, shown in Fig. 5, are attached to each of the lights so that spark-gap B is close to the mantle. The induction coil raises the voltage of the dry cells to a high point, so that it forces a spark across the air gap, and the gas which has been turned on to the light is ignited by this spark. The diagram in Fig. 4 shows how a switch C can be placed in the secondary circuit and, by means of it, groups of lights lighted one after the other.



-Fig.1-



-Fig.2-



-Fig.3.-

-MAGNET COCK-

This system of ignition has been used with much success and it has been found to be very good for use in buildings where a large number of lights have to be ignited at the same time.

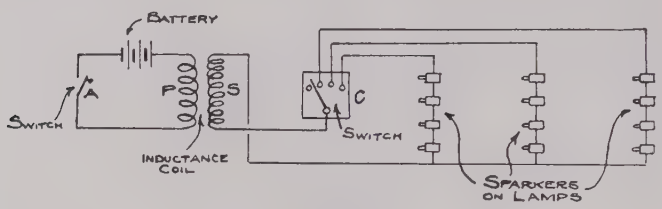


FIG. 4
JUMP SPARK SYSTEM

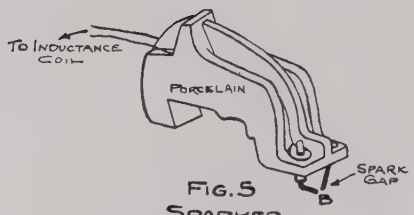


FIG. 5
SPARKER

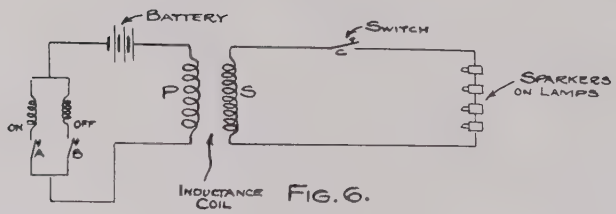


FIG. 6.

COMBINATION OF JUMP SPARK & MAGNET VALVE SYSTEMS

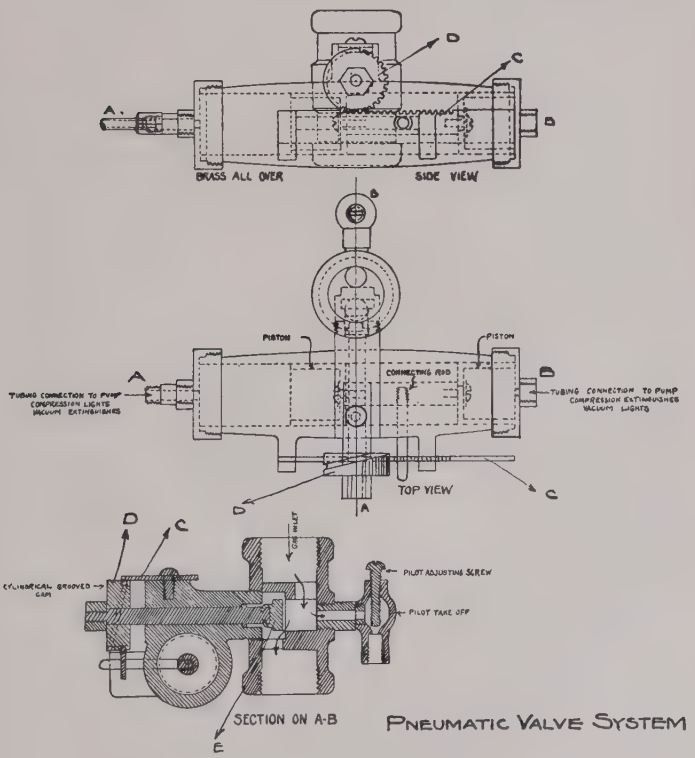
Fig. 6 shows how the magnet cock and the jump spark system may be combined, the former being used to turn the gas on and off, and the latter to ignite it.

It has been found that a battery of 6 dry cells connected in series give very satisfactory results in lighting 7 or 8 lights.

This system is practically instantaneous also, and is very reliable. It requires very little attention, and, as a whole, gives very good results when used to light several lights at one time.

Pneumatic Valve System.

This valve is used to control the flow of gas from a distance. The gas is ignited by means of the pilot light generally. The



PNEUMATIC VALVE SYSTEM

valve is placed in the piping above the fixture. It is shown in the illustration in elevation and cross section. It is a pneumatic device, there being a pump placed on the wall at a con-

venient point. A small tube runs from the cylinder of this pump and is connected to the valve at either A or B, the other one being left open to the atmosphere. By pushing in on the plunger, the pressure on the one side of the double piston of the valve is increased. This forces the piston over and the rack C, which it carries, rotates the cylinder cam D. This unseats the valve E and allows the gas to the light, where the pilot ignites it. In like manner when the plunger on the pump is pulled out, a vacuum is formed on the one side of the piston of the valve, causing it to move in the opposite direction, seating the valve E and shutting the gas off.

Gas Pressure System.

The essential parts of this system are shown in Figs. 7, 8 and 9. Figs. 7 and 8 are two views of the valve or cock, which is placed at some convenient point at a distance from the light. It is placed directly in the gas line leading to the light, and it is similar to the ordinary gas cock, the only difference being that this cock has a groove cut in it so that the gas for the pilot light may leak by when the cock is closed. This pilot gas is controlled by means of the screw A. Fig. 9 shows the valve that is placed directly above the light, the gas coming in at B and going out to the light at C. When the cock at the wall is closed, and only the gas for the pilot is entering the valve, the pressure isn't great enough to lift the small valve D from its seat, so that the gas flows around and out of the pilot tube to the pilot. Now, when the gas is turned on under full pressure, the valve D is lifted and gas flows past it to the light where it is ignited by the pilot. The small ball at E is supposed to shut off the pilot as soon as the light is lighted.

This system of distance lighting has been in operation in several installations for quite some time and has given satisfaction. It is positive and requires little attention.

Filament Ignition System.

The system employing the magnet cock and hot wire or filament consists of a small filament of finely drawn wire made

of an alloy of platinum, which when heated to a certain point, has what is known as "catalytic" properties; *i. e.*, the property

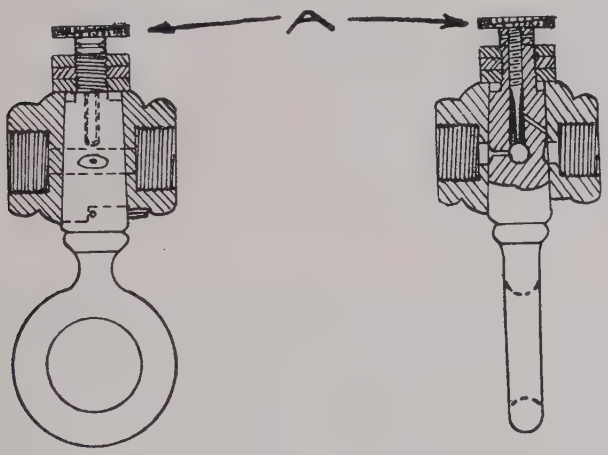


FIG. 7

FIG. 8

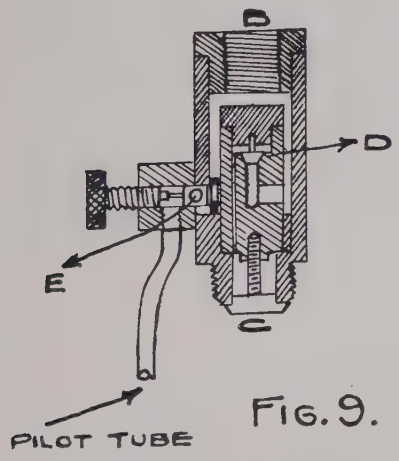


FIG. 9.

GAS PRESSURE SYSTEM

of having its temperature increased due to the action of the stream of combustible gas. This filament is placed on the

burner and connected in series with the opening side of the magnet cock, which is wired to some distant point where a white and black button switch is located. On closing the circuit, by pushing the white button, the gas valve is opened and the filament igniter is heated by the current to the point where the catalytic action begins, about 500° F., and by this action has its temperature raised to the kindling temperature of the gaseous stream, at which point it ignites this gaseous mixture and thus lights the lamp or lamps. On closing the circuit again, by pushing the black button, the gas valve is closed and

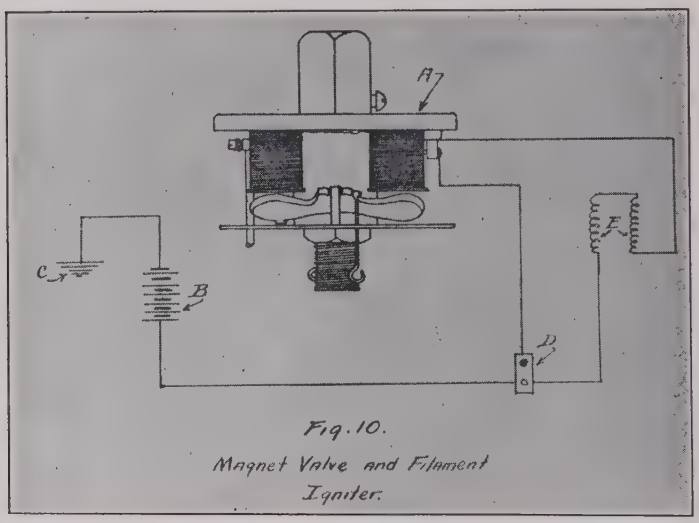


Fig. 10.

Magnet Valve and Filament Igniter.

the lamp or lamps extinguished. By this means, the utmost fool-proofness is insured, by reason of the connections of this system, if the filament, through any cause whatever, will not operate, the pushing of the white button will not cause the gas valve to be opened.

This system has been in use, for example, over a period of several years in a large modern office building, in one of the large cities, lighted throughout by gas and with entire success.

Fig. 10 shows the combination of the magnet valve and the filament igniter, in this case for two lamps. The valve is

shown at A, the battery at B, the grounded connection at C, the electric switch at D, and the filament igniters at E.

Sec. E.—Economical Comparison of Gas and Electric Lighting Operating Indoors.

Explanation of Charts.

Chart No. 1. Reflex light vs. tungsten lamp.

Assumptions:—

Reflex gas lamp.....	Cost of gas	$1.00 per 1,000 cu. ft.
	Renewals	2 mantles per year @ 25¢
	Consumption	3. 75 cu. ft. per hour
	Candle-power	59
60 – Watt tungsten lamp.....	Cost of electricity	$0.10 per kw. hr.
	Renewals.....	1 60-watt tung. lamp @ $1.00
	Consumption	60 watts per hour
	Efficiency of lamp	1.38
	Candle-power.....	43.5

Average operating year in both cases 1,300 hours.

The assumptions for the gas light were made from the results of Tests, while those for the tungsten lamp were made from the table given in the *Engineering Bulletin* of the N. E. L. A.

Gas	Cost of gas $3.75 \times 1{,}300 \times \frac{1.00}{1{,}000}$	$4.88
	" " renewals @ 25¢	0.50
	" " operating per year of 1,300 hours	$5.38
Electricity..	Cost of electricity $60 \times 1{,}300 \times \frac{0.10}{1{,}000}$	$7.80
	" " renewals @ $1.00	1.00
	" " operation per year of 1,300 hours.....	$8.80

From these and similar calculations for various costs of energy Chart No. 1 was drawn. The 60-watt tungsten lamp was considered because it is the average lamp used in installations in large buildings.

Chart. No. 2. Reflex lamp vs. tungsten lamp.
(1 w. p. c.)

The same cost of operation of the gas lights was taken as for Chart No. 1. For the tungsten lamp, the costs were the same, but the candle-power became 60 instead of 43.5.

Chart No. 3 Reflex lamp vs. tungsten lamp (with free renewals for the latter).

The costs for the gas lamp will be the same as before.

Assumptions :—

60 Watt tungsten lamp.

Cost of electricity	$0.10 per k. w. hr.
Efficiency of lamp	1 w. p .c.
Candle-power	60
Consumption	60 watts per hour
Renewals	Free

$$\text{Cost of energy } 60 \times 1{,}300 \times \frac{0.10}{1{,}000} \$7.80$$

Chart No. 4. Reflex lamp vs. tungsten lamp.

The operating costs of the gas lamp were taken as the same as for Chart No 1.

Assuming the cost of the 60-watt tungsten lamp to be $0.35 and conditions being the same as before,

Cost of energy @ 10¢ per kw. hr. per year

$$1{,}300 \times 60 \times \frac{0.10}{1{,}000} \$7.80$$

Cost of renewals per year @ 0.35 0.35

Candle-power 60.0

From these charts and similar calculations, Chart No. 4 was drawn.

Chart No. 5. Gas arcs vs. nitrogen filled tungsten lamps.

The H. P. and L. P. gas arcs were compared with the 500-watt nitrogen filled tungsten lamps,

Assumptions :

L. P. gas arcs:

Consumption of 4 mantle arc	16 cu. ft. per hour
Renewals 16 mantles per year	@ 12¢
4 nozzles " "	@ 8¢
1 globe " "	@ 50¢
M. S. candle-power	300
Consumption of pilot (Continuous burning)	0.25 cu. ft. per hour

H. P. arc:

Consumption of 2 burner arc	22 cu. ft. per hour
(Consumption of pilot only when light is out.)	0.25 cu. ft. per hour
12 mantles per year	@ 28¢

Renewals	4 nozzles " "	@ 75¢
	1 globe " "	@ $1.00
Cost of compressing gas		4 watts per hour per lamp at 10¢ per kw. hour.
M. S. candle-power		675
500-Watt nitrogen filled tungsten lamp	Consumption of nitrogen lamp	500 watts per hr.
	Efficiency of lamp	0.5 W. P. C.
	Cost of renewals per year	@ $5.50 $5.50

Average operating year in each case was taken as 1,300 hours.

Considering, at first, the cost of L. P. gas to be $1.00 per M. cu. ft. and cost of electricity to be $0.10 per kw. hr.—

L. P. gas arcs	Cost of gas per year $16 \times 1{,}300 \times \frac{1.00}{1{,}000}$	$20.80
	" " " for pilot $0.25 \times 8{,}700 \times \frac{1.00}{1{,}000}$	2.18
	" " 16 mantles @ 12¢	1.92
	" " 4 No. 92 tips @ 8¢	0.32
	" " 1 intenson globe @ 50¢	0.50
	Operating cost per year	$25.72
	Candle-power	300
H. P. arcs ..	Cost of gas per year $22 \times 1{,}300 \times \frac{1.00}{1{,}000}$	$28.60
	" " " for pilot (8,700–1,300) $\times 0.25 \times \frac{1.00}{1{,}000}$	1.85
	" " 12 mantles @ 28¢	3.36
	" " 4 nozzles @ 75¢	3.00
	" " 1 globe @ $1.00	1.00
	Cost of compressing gas, per yr. $4 \times 1{,}300 \times \frac{0.10}{1{,}000}$	0.52
	Operating cost per yr. of 1,300 hrs.	$38.33
	Candle-power	675
500-Watt nitrogen filled	Cost of electricity @ 10¢ per kw. hr. $1{,}300 \times 500 \times \frac{0.10}{1.000}$	$65.00
	Cost of renewals	5.50
	Operating cost per yr. of 1,300 hrs.	$70.50
	Candle-power $\frac{500}{0.5}$	1,000

From these and similar calculations for various costs of energy Chart No. 5 was drawn.

For a comparison under conditions as above:—

For the L. P. arc:

Cost of operating per year per candle-power $\frac{\$25.72}{300}$ $0.086

Cost for the H. P. arc:

Cost of operating per year per candle-power $\frac{\$38.3}{675}$ $0.057

For nitrogen filled tungsten lamp:

Cost of operating per year per candle-power $\frac{\$70.50}{1,000}$ $0.071

These charts cover all conditions, excepting the primary and secondary rates of the electric companies. It would be hard to make a general comparison of the gas and electric lights taking this item into consideration, because each specific case is different. For a general comparison, we need not consider this.

Chart No. 1: From this chart, we readily see that at the costs of energy, as found in most large cities, the gas light is much more economical than the electric. For the same amount of illumination, and gas selling at $1.00 per 1,000 cu. ft., the electric company would have to sell electricity for about 4.0 cents per kw. hr., in order that the cost of operation will be the same. This chart gives the tungsten lamp an efficiency of only 1.38 w. p. c., and, while the tungsten lamp will give better results than this in the laboratory, it is doubtful whether it is attained in practice.

Chart No. 2: This chart credits the tungsten lamp with 1 w. p. c., and we see that the gas light is still much more economical. With gas at $1.00 per 1,000 cu. ft., for the same amount of illuminating and the same cost of operation, the electricity would have to be selling at about 5½ cents per kw. hr.

Chart No. 3: This chart goes even farther, in considering that the electric companies give free renewals on the tungsten lamps, and still the gas light shows up more economically. To compete with the gas company selling gas at $1.00 per 1,000

cu. ft., for the same amount of illumination, the electric companies would have to sell current at about 7 cents per kw. hr.

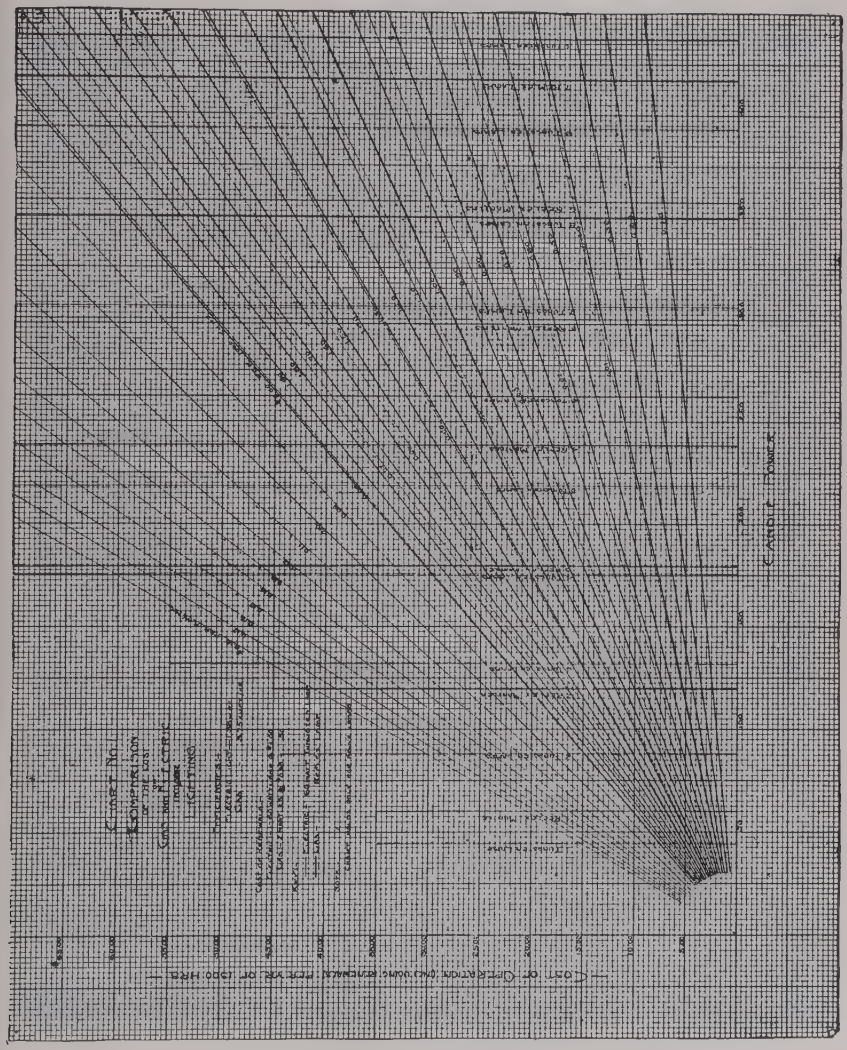
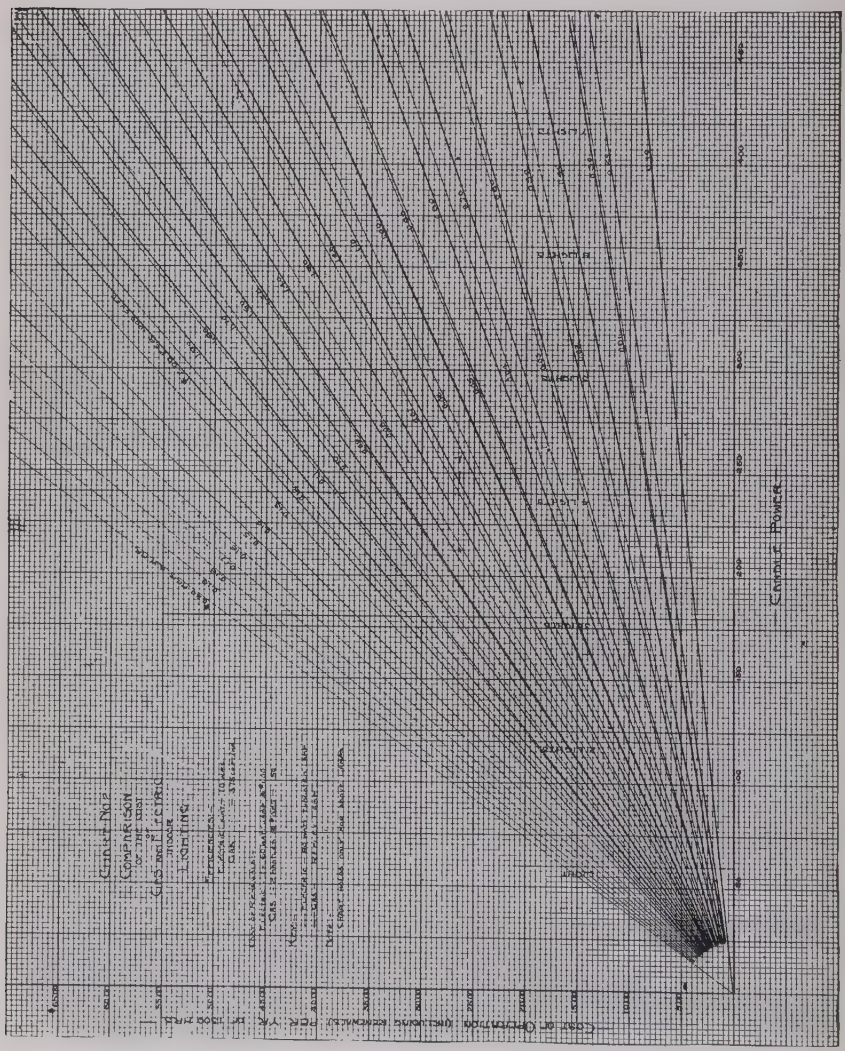


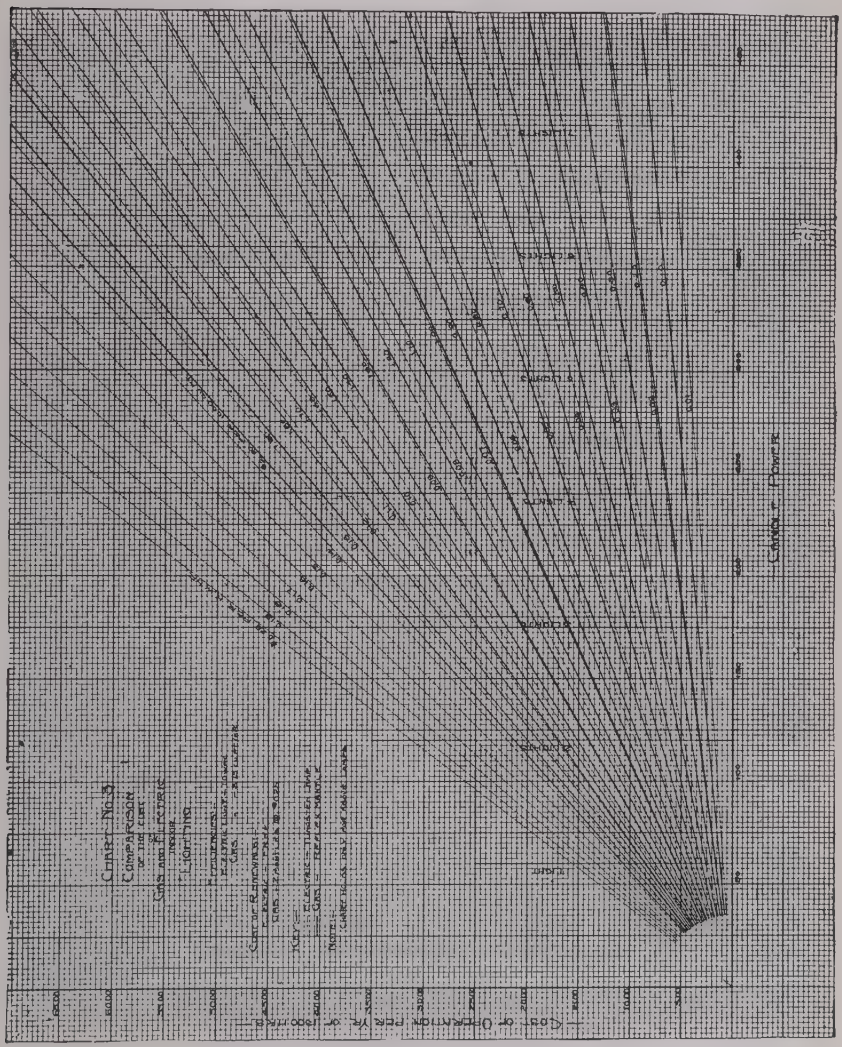
Chart No. 4: This chart is the same as Chart No. 2, with the exception of the cost of the tungsten lamp, which in this

case is taken as 35 cents, and we find that, with gas at $1.00 per 1,000 cu. ft., the electric company, in order to make the



cost of operation the same, would have to sell current at about 6½ cents. It should also be noted here that the quality of

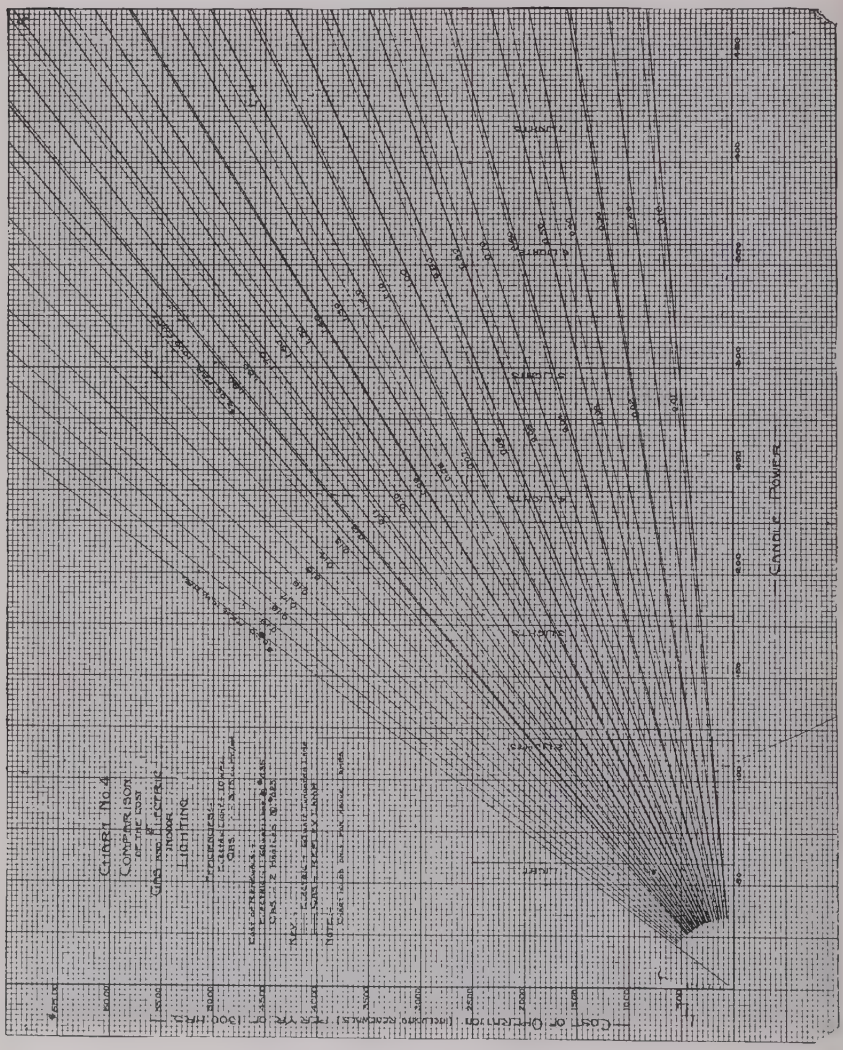
the lamp in this case is liable to decrease, and in that case the



cost of renewals would increase and make the gas light even more economical than the chart shows.

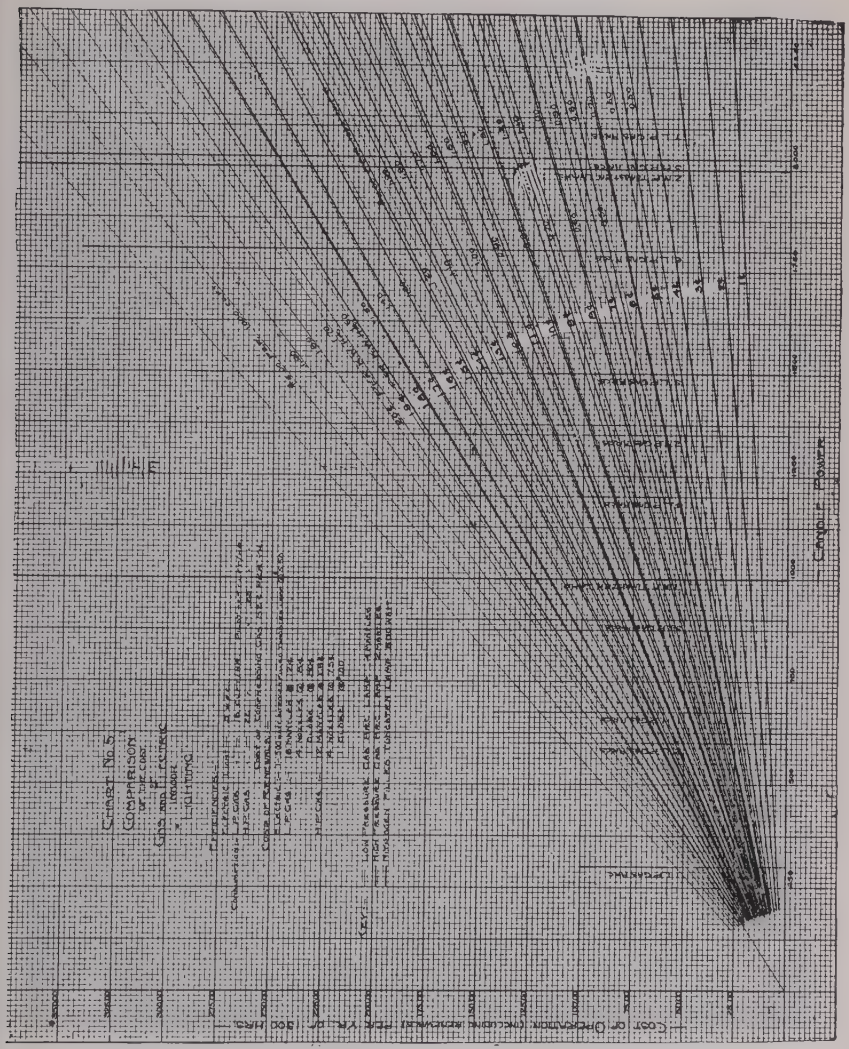
Chart No. 5: Here a comparison is made between the

L. P. gas arc, the H. P. gas arc and the new product of the



General Electric Company, the nitrogen-filled tungsten lamp. From the chart we see that the new tungsten lamp is more

economical than the L. P. gas arc, but not as economical as the H. P. gas arc.



Sec. F.—Fuel Illustrations.

Index.

The following are the trades or industries represented in the illustrations with the illustration numbers:

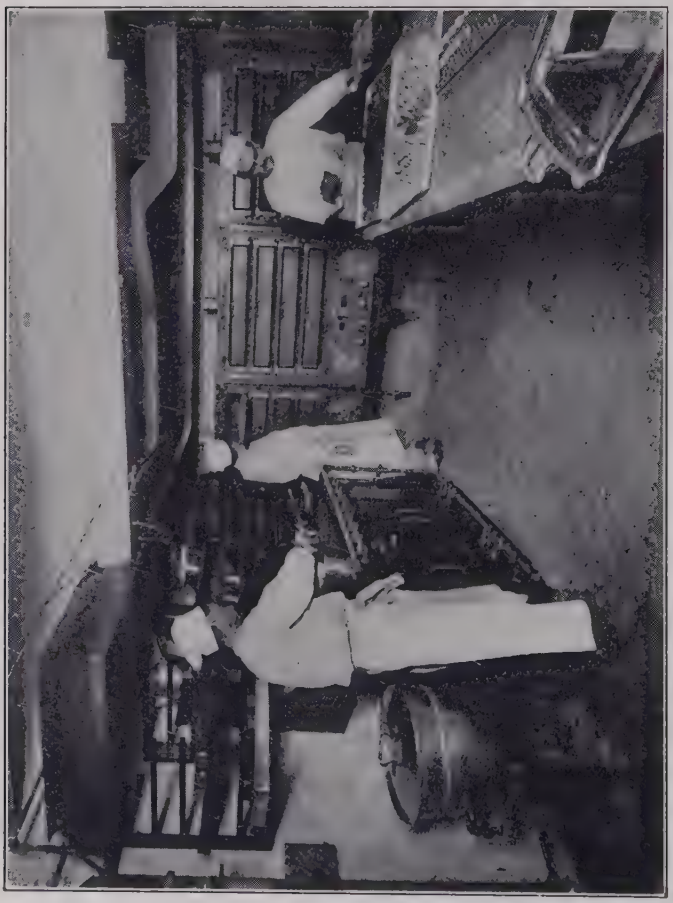
Illustration No.	Trade or industry
1	Wholesale bakers
2	Brass bed manufacturing
3	Biscuit and waffle making
4	Wholesale confectioners
5	Manufacturing chemists
6	Clothing manufacturing
7	China making
8	Coffee blending
9	Electrotyping
10	Glass bending
11	Glassworking
12	Hatters
13	Ink manufacturing
14	Ice cream cone manufacturing
15	Manufacturing jewelers
16	Manufacturing jewelers
17	Laboratories
18	Laboratories
19	Laboratories
20	Laundries
21	Laundries
22	Millinery supplies
23	Metal working
24	Metal finishing
25	Metal smelting
26	Motor supplies manufacturing
27	Manufacturing machinists
28	Novelty manufacturing
29	Necktie manufacturing
30	Polish manufacturing
31	Printing
32	Photography
33	Popcorn preparation
34	Peanut roasting
35	Rubber goods manufacturing
36	Refining metals
37	Scale manufacturing

Illustration No.	Trade or industry
38	Stained glass manufacturing
39	Silversmiths
40	Stamp manufacturing
41	Tire manufacturing
42	Tool making
43	Thermos bottle manufacturing
44	Wax form manufacturing
45	Wheel and tire manufacturing

Types of appliances shown in illustrations with illustration numbers:

Appliance	Illustration No.
Assay furnace	36
Annealing oven	42, 43
Bake oven	1, 4
Baking machine	3
Blow torches	10, 16
Bench forge	37
Confectioner's stove	1, 4
Coffee roaster	8
Cauldron	4
Case table	9
Cone baking machines	14
Conditioning ovens	19
Drying ovens	32
Extractor	20
Flash kiln	38
Feather steamer	22
Glue pot	28
Glue heater	28
Gas irons	29
Hotel range	1
Heating table	9
Hat stamping machines	12
Hot plate for mould drying	40
Ironing machine	21
Japanning oven	2, 23, 24
Kilns	7, 39
Melting furnace	36
Melting pot	15
Mould dryer	15
Muffle furnace	37
Oven furnace	37
Popcorn poppers	33
Peanut roasters	34
Radiator drying oven	17
Revolving drying oven	26
Steam boiler	5, 30, 31
Soldering iron heaters	11, 27
Special cooking stoves	13

Appliance	Illustration No.
Sterilizing oven	17
Sterilizer	18
Smelting furnace	25
Steam jacketed kettle	30
Tire heater	41, 45
Vulcanizers	35
Water heater	6, 44
Washing machine	20
Waffle machine	3
Wax pot	9

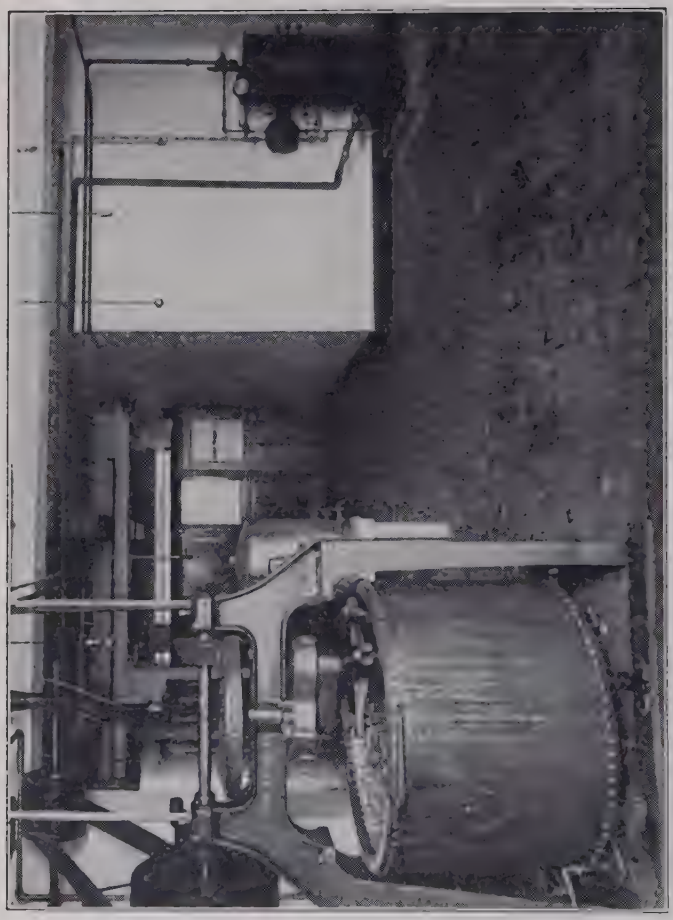


No. 1.—Range. Bake ovens.

No. 2.—Japanning oven.

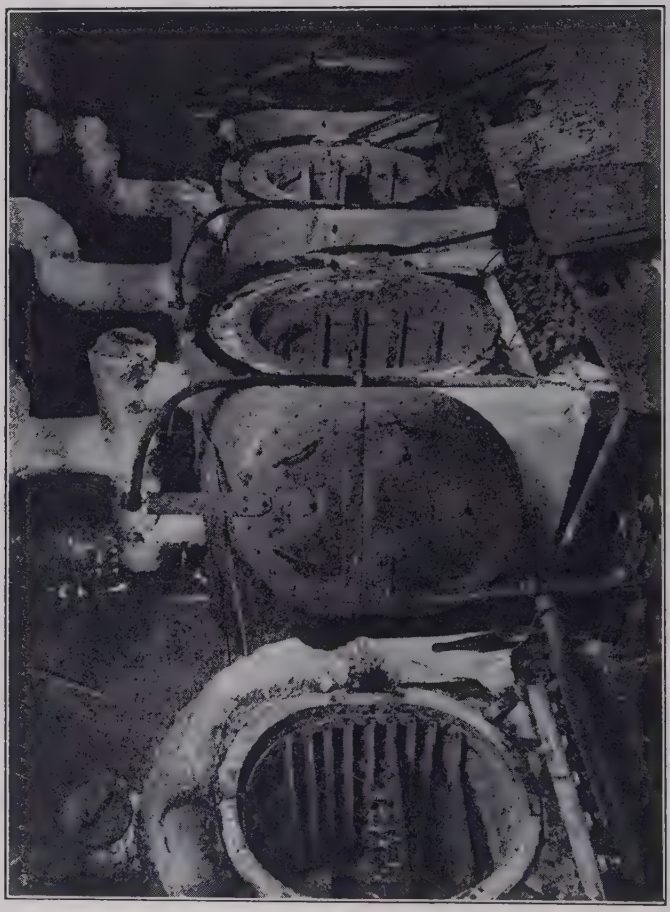
No. 3.—Baking machine. Waffle machine

No. 4.—Cauldron. Confectioners' stove. Bake oven.



No. 5.—Steam boiler.

No. 6.—Water heater.



No. 7.—Kilns.

No. 8.—Coffee roaster.

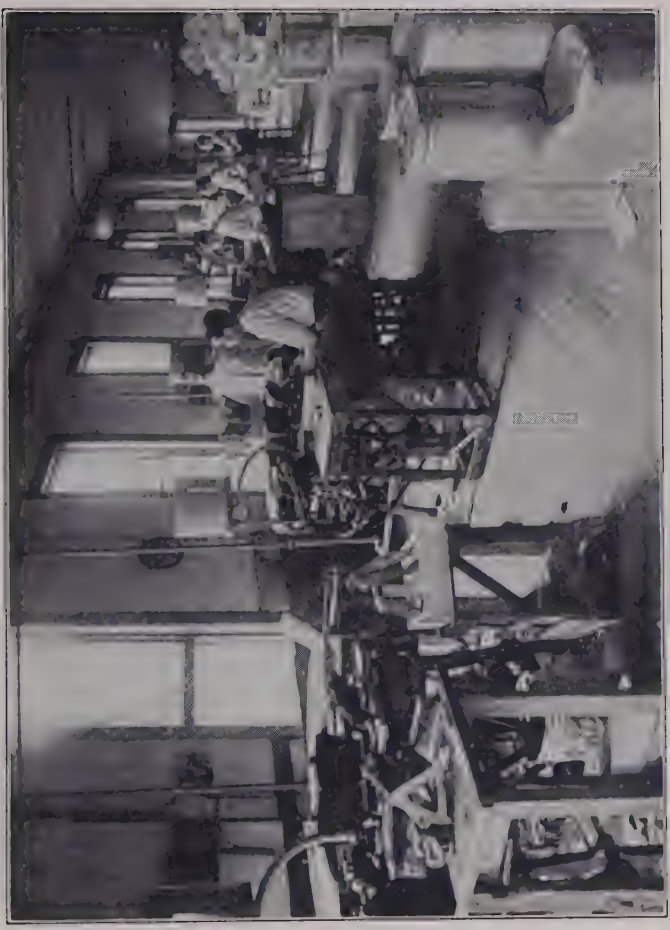
No. 9.—Case table. Heating table. Wax pots.

No. 10.—Blow torches.

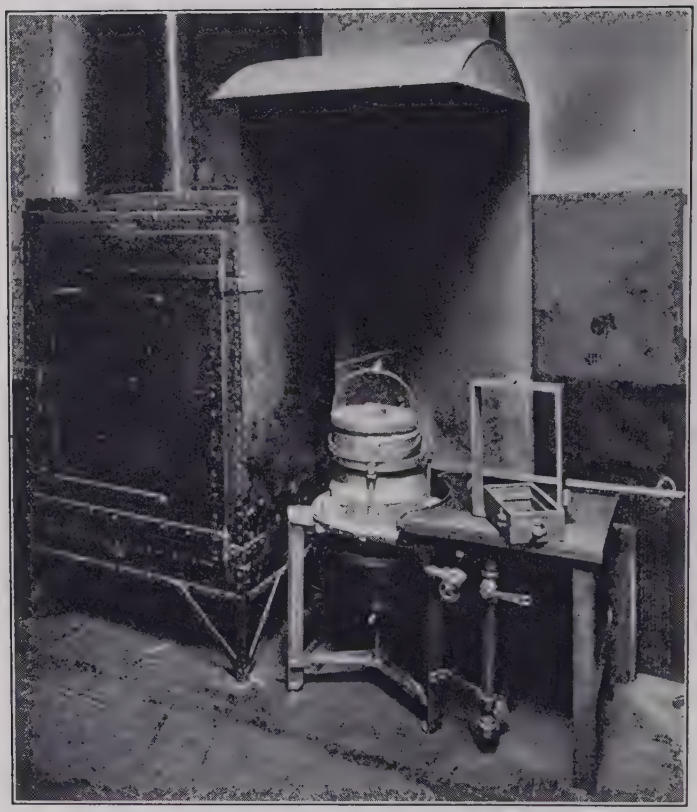
No. 11.—Soldering iron heaters.

No. 12.—Hat stamping machines.

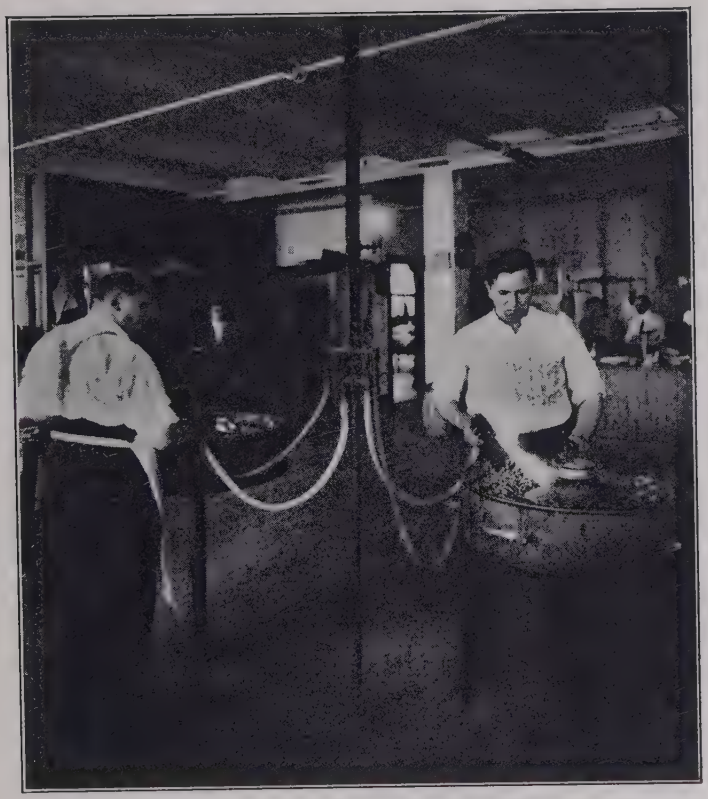
No. 13. Special cooking stoves.



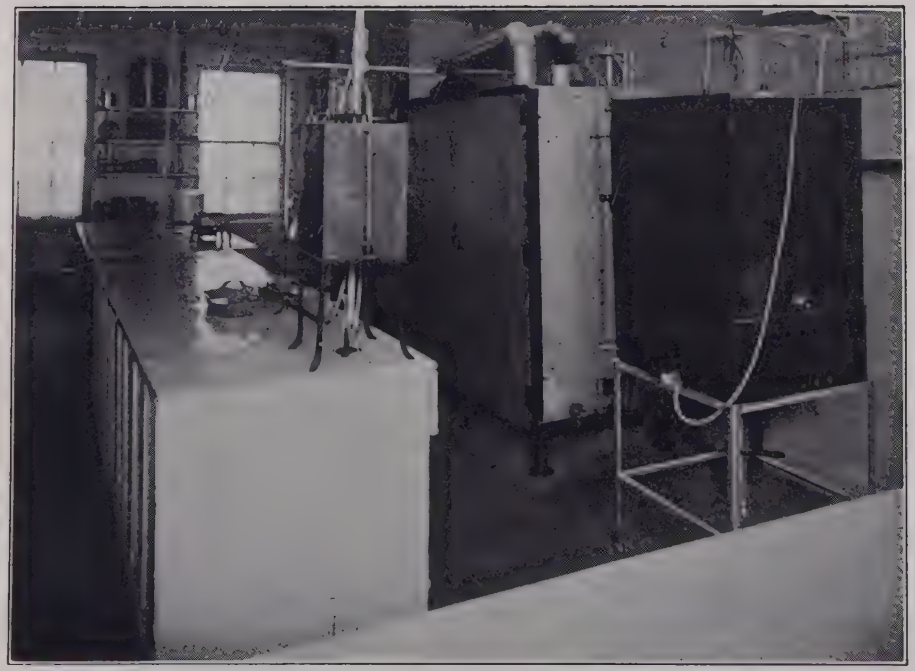
No. 14.—Cone baking machines.



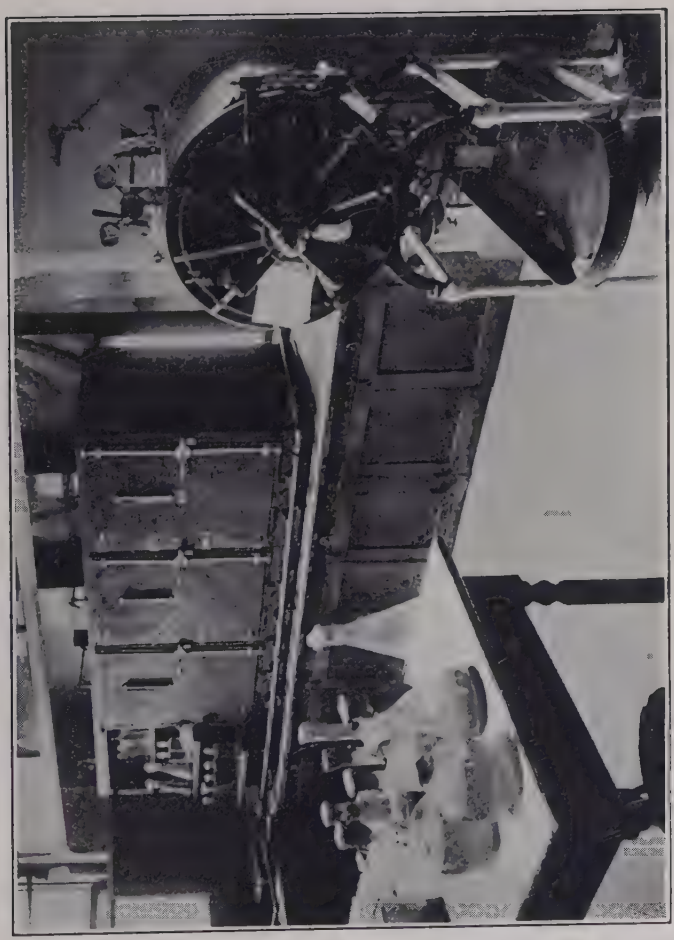
No. 15.—Mould dryer. Melting pot.



No. 16.—Blow torches.

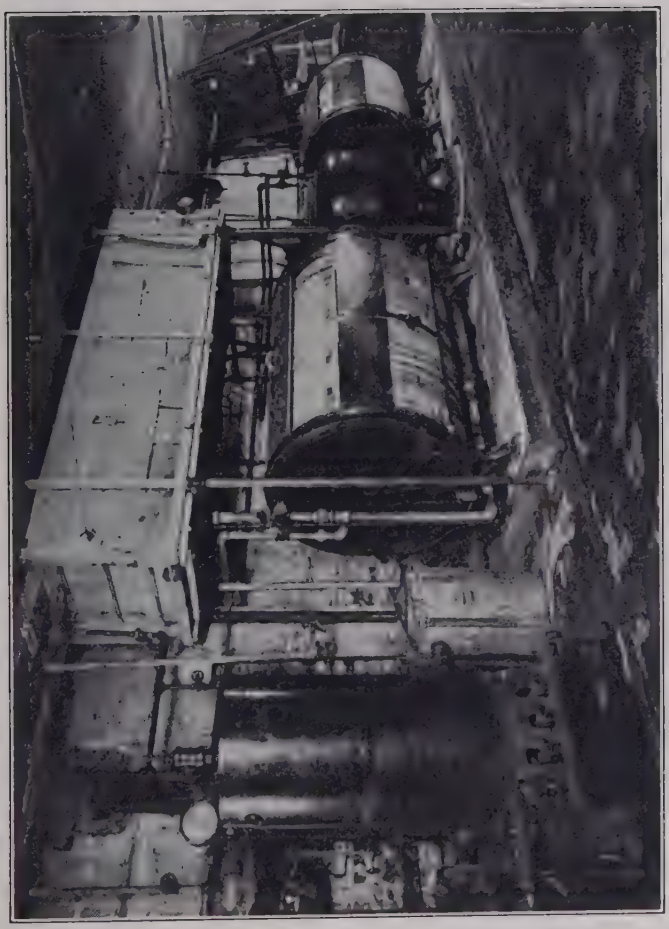


No. 17.—Radtator drying oven. Sterilizing oven.

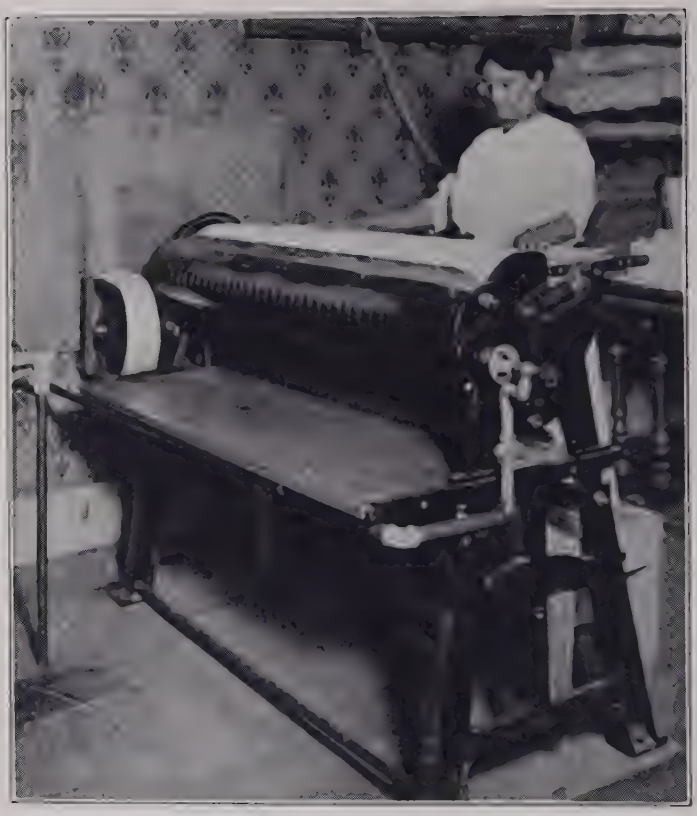


No. 18.—Sterilizer.

No. 19.—Conditioning ovens.



No. 20.—Extractor. Washing machine.



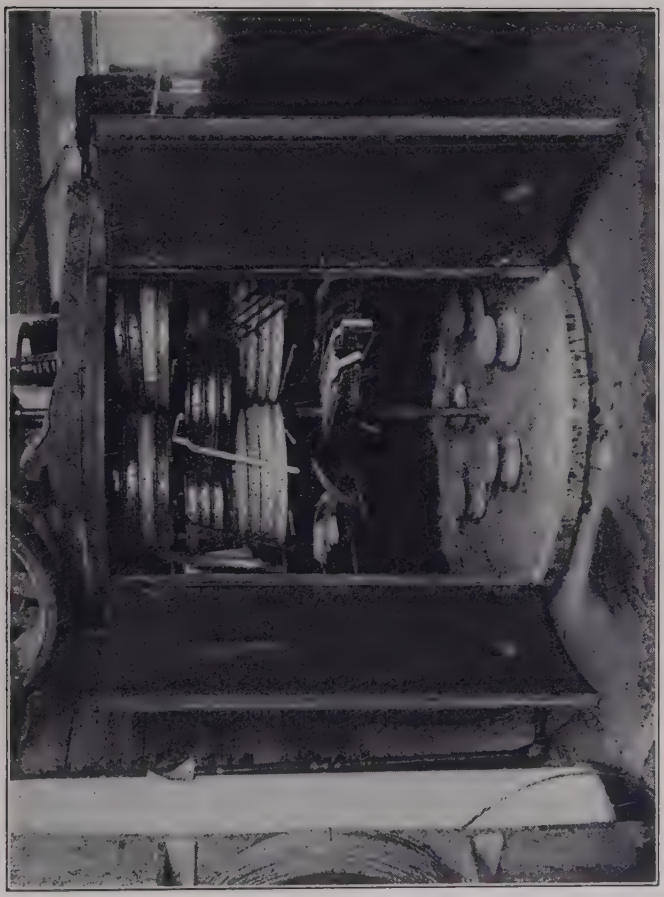
No. 21.—Ironing machine.

No. 22.—Feather steamer.

No. 23. Japanning oven.

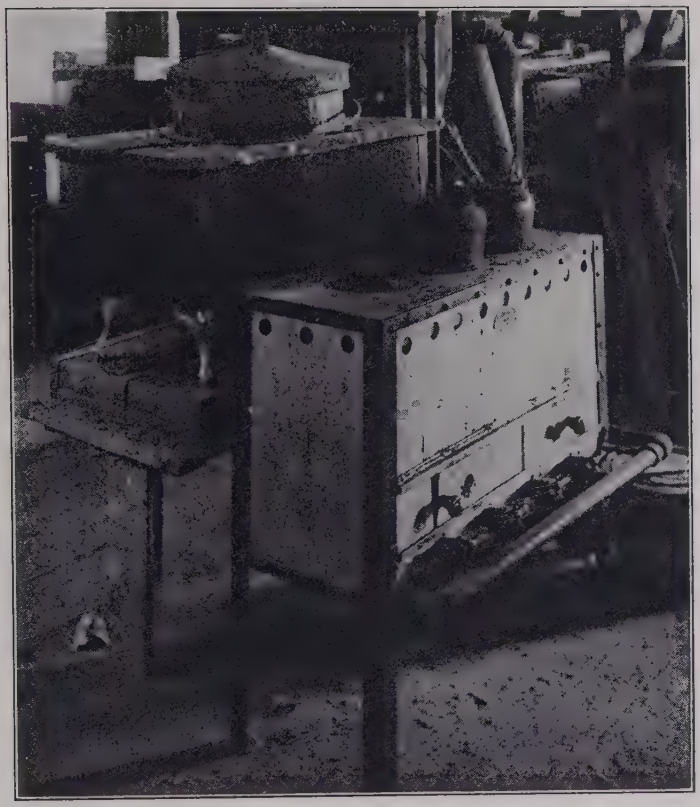
No. 24.—Japanning oven.

No. 25.—Smelting furnace.

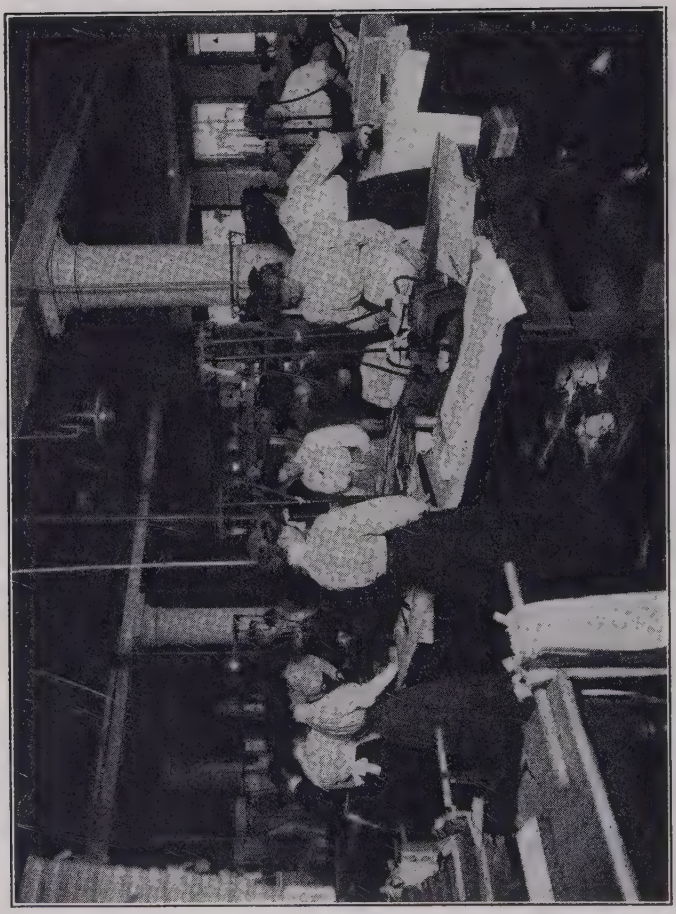


No. 26.—Revolving drying oven.

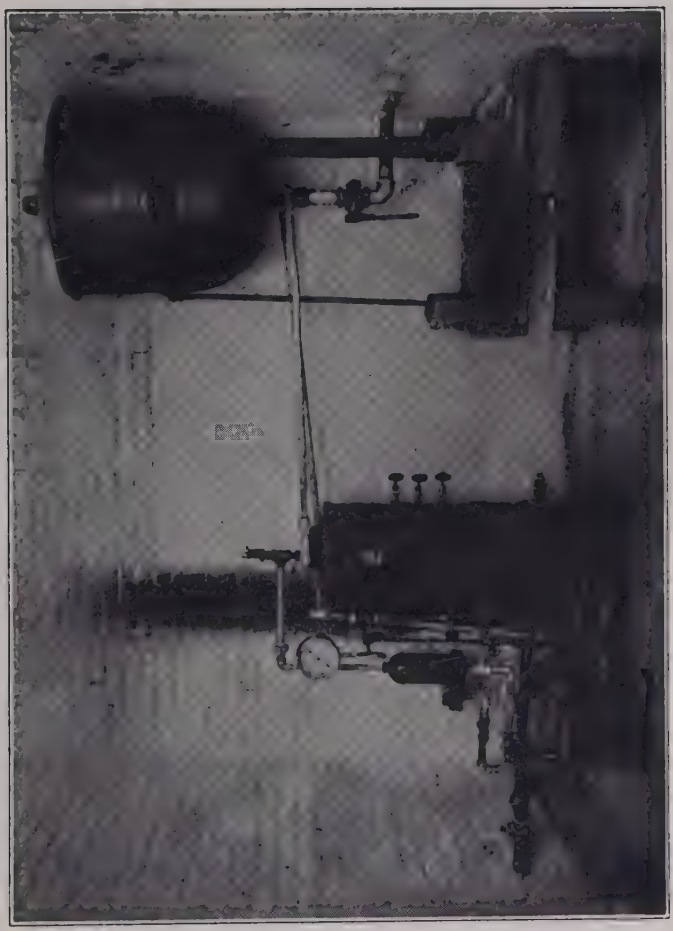
No. 27.—Soldering iron heaters.



No. 28.—Glue pot. Glue heater.



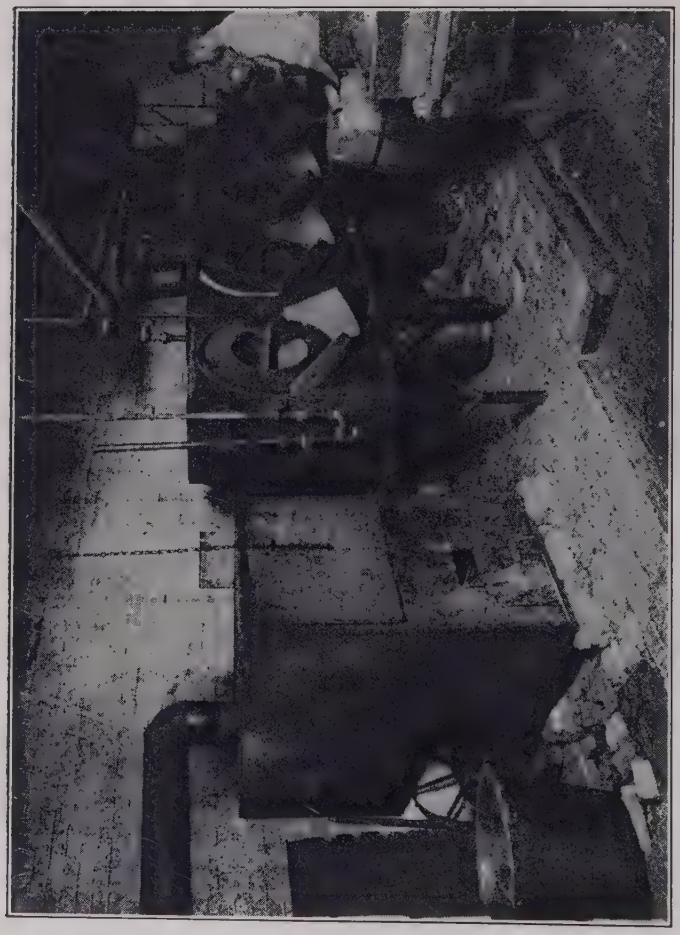
No. 29.—Gas irons.



No. 30.—Steam boiler. Steam jacketed kettle.

No. 31.—Steam boiler

No. 32.—Drying oven.

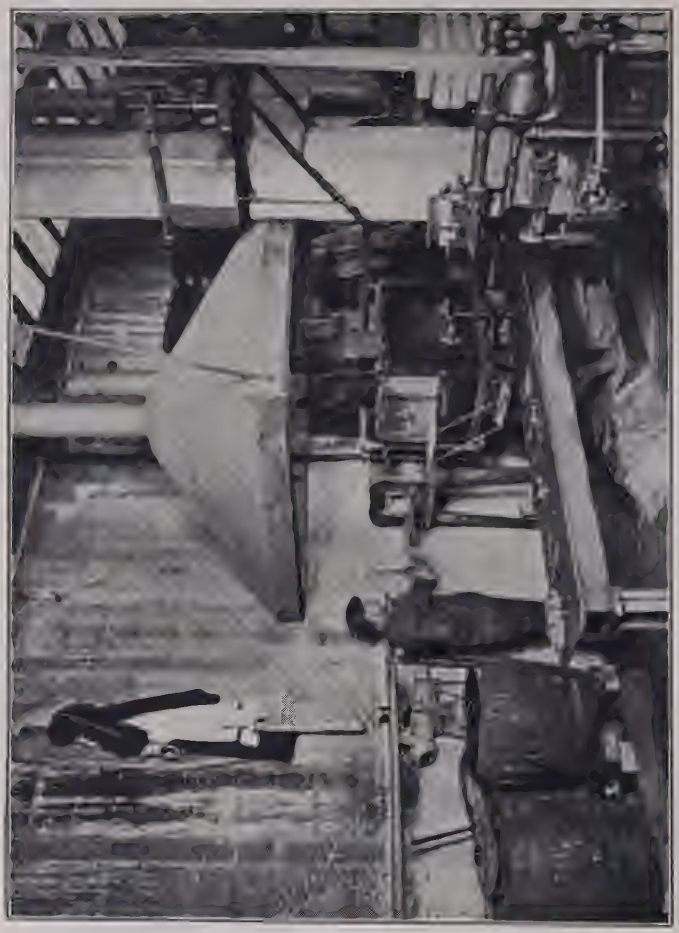


No. 33.—Popcorn poppers.

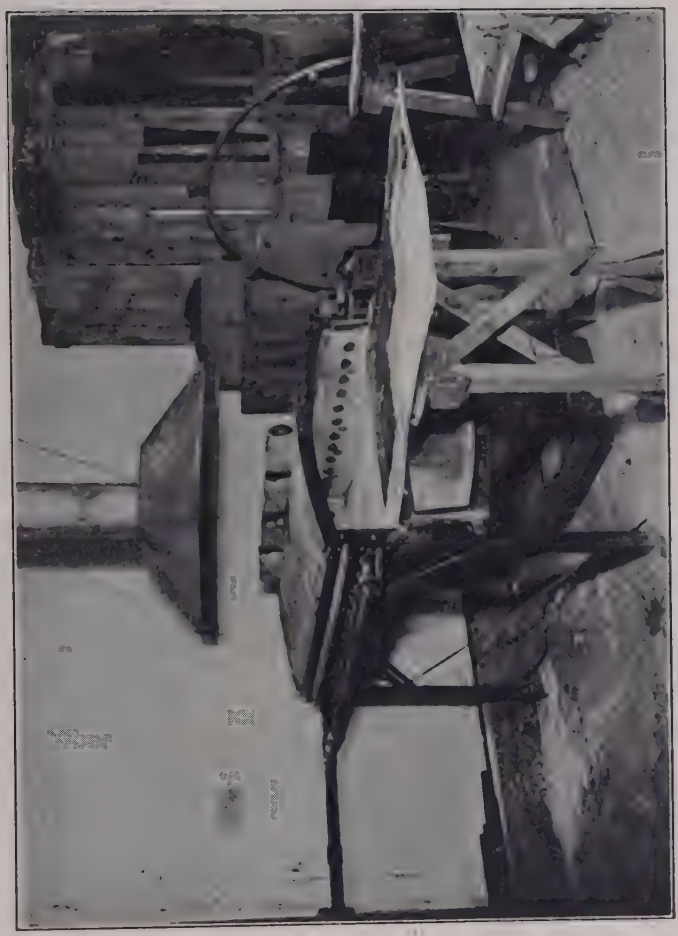
No. 34.—Peanut roasters.

No. 35.—Vulcanizers.

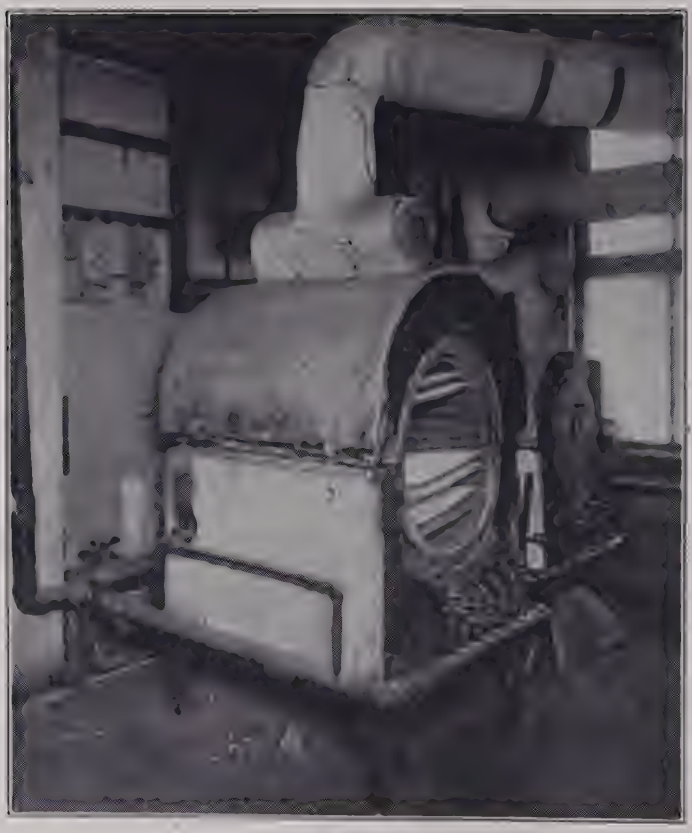
No. 36.—Assay furnace. Melting furnace.



No. 37.—Oven furnace. Bench forge. Muffle furnace.



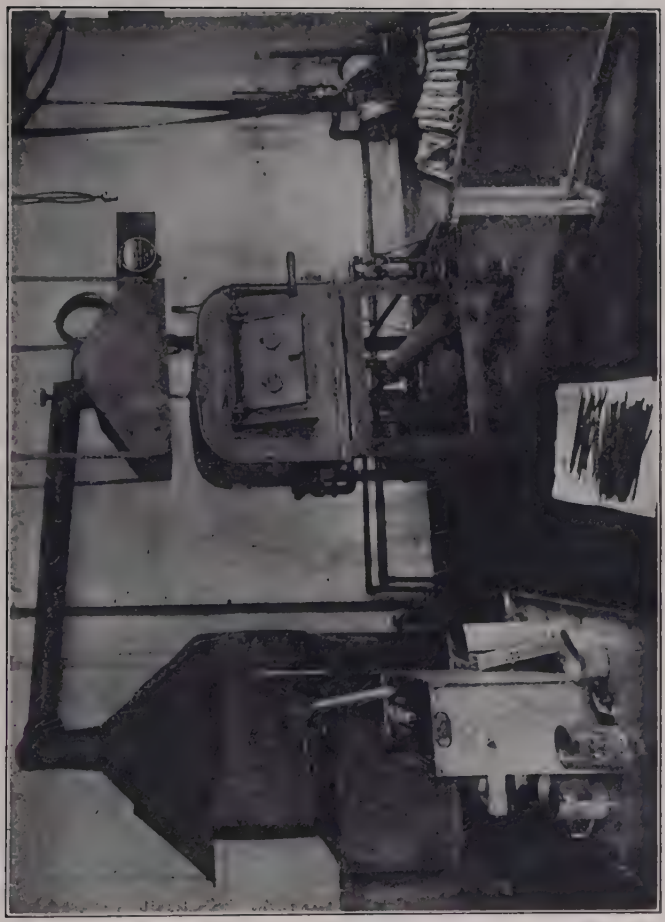
No. 38.—Flash kiln.



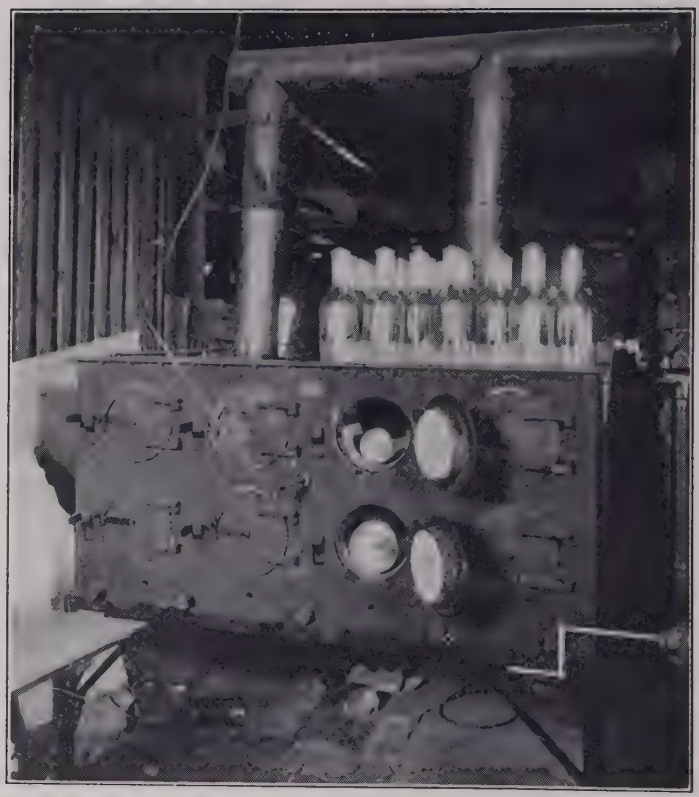
No. 39.—Kilns.

No. 40.—Hot-plate for mould drying.

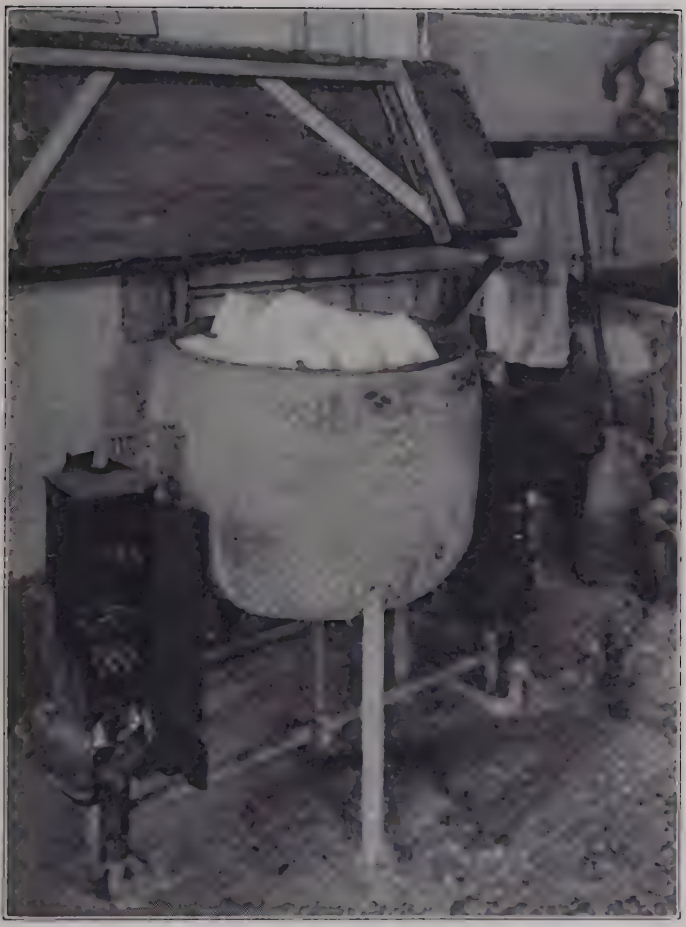
No. 41.—Tire heater.



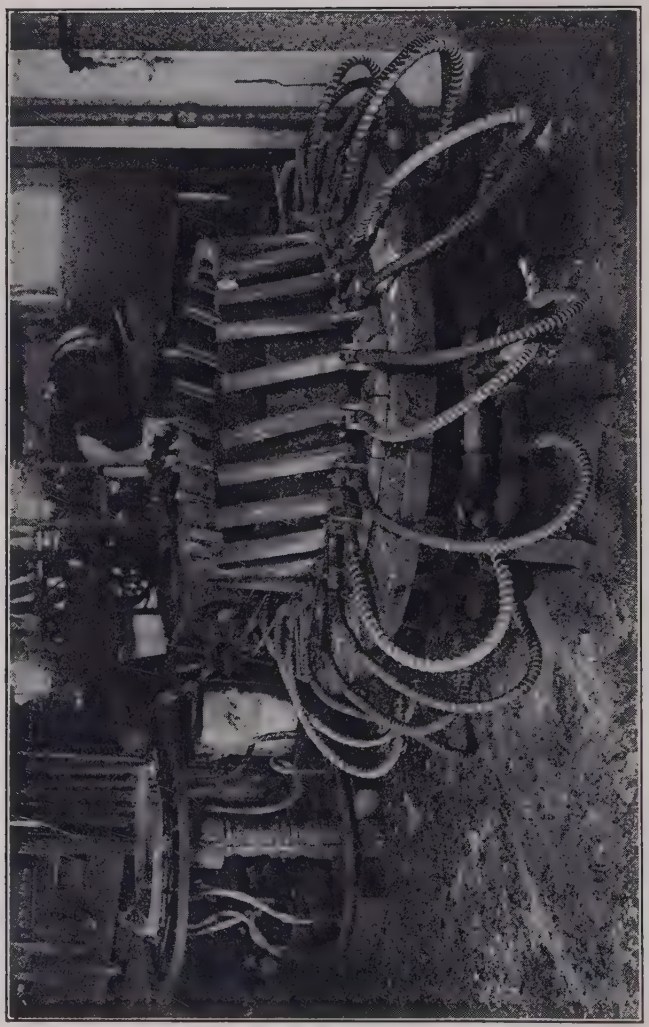
No. 42.—Annealing oven.



No. 43.—Annealing oven.

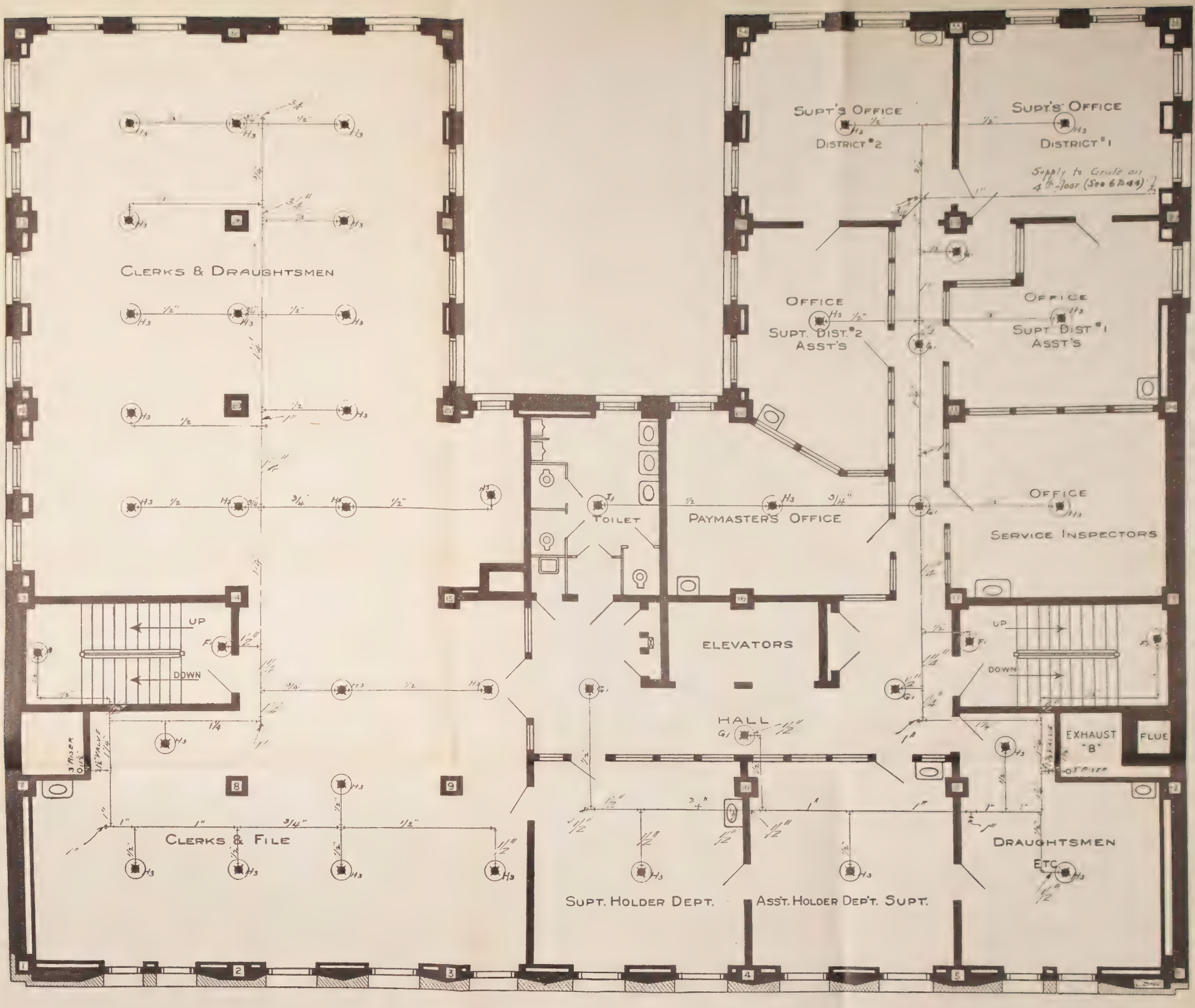


No. 44.—Water heater.



No. 45.—Tire heater.

Sec. G.—Piping Plans.



THIRD FLOOR PLAN

Note. Piping shown on this plan is to be Located in the 4th floor with drops to supply fixtures as shown.

Note In all rooms having a single drop fixture Locate same in Center of Room.
Locate all hall drop fixtures centrally between side Walls.

Note
Fixtures shown dotted are on Floor above but are to be supplied from this Floor. (See 6B41)

Outlet for Gas Log on Floor above (See 6B41)

Wall Light

Floor outlet in Telephone Room on Floor above for future connection to Gas heater

Riser to future Wall Light in Telephone Room on Floor above

Partition in Telephone Room.

Partition in Telephone Room

Riser to future Wall Light in Telephone Room on Floor above.

Partition on Floor above

Cap in floor

Smoke Vent Shaft

REMSEN ST.

FOURTH FLOOR PLAN

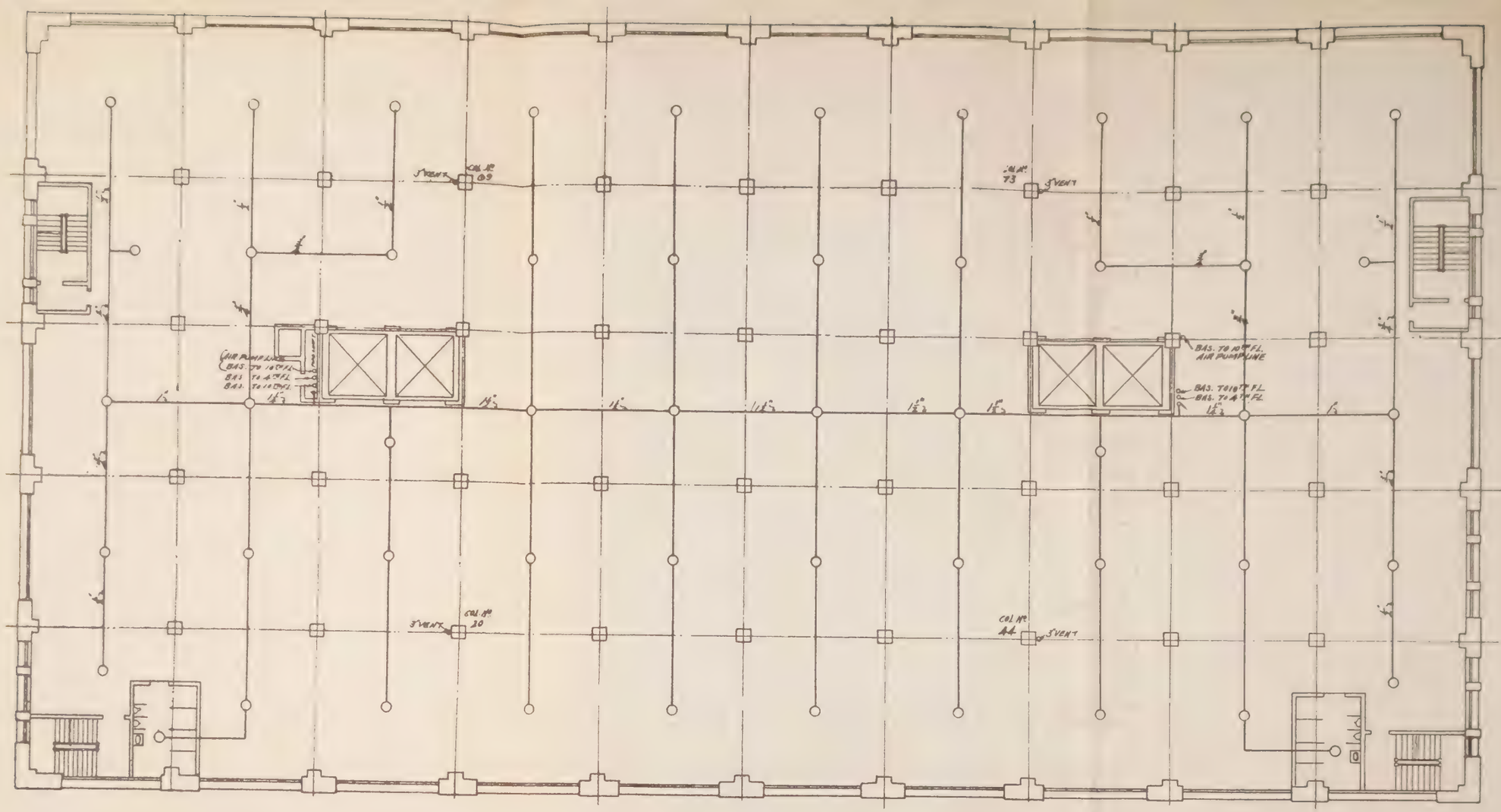
Note. All Piping for Wall Lights to be concealed

Fixtures in Circles thus (G1) are required now. See Letter of L. S. Stites dated 2/25/14

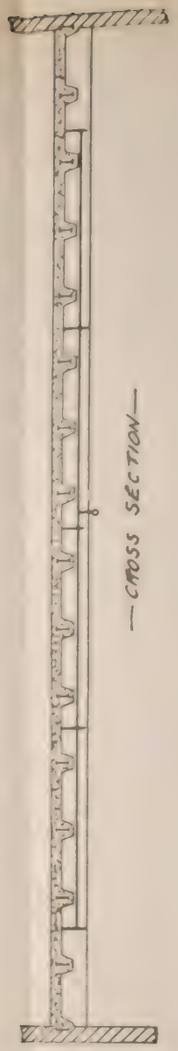
Note. Piping shown on this plan is to be located in the 5th floor with drops to supply fixtures as shown.

Note. In all Rooms having a single drop fixture locate same in center of Room.
Locate all hall drop fixtures centrally between Side Walls.

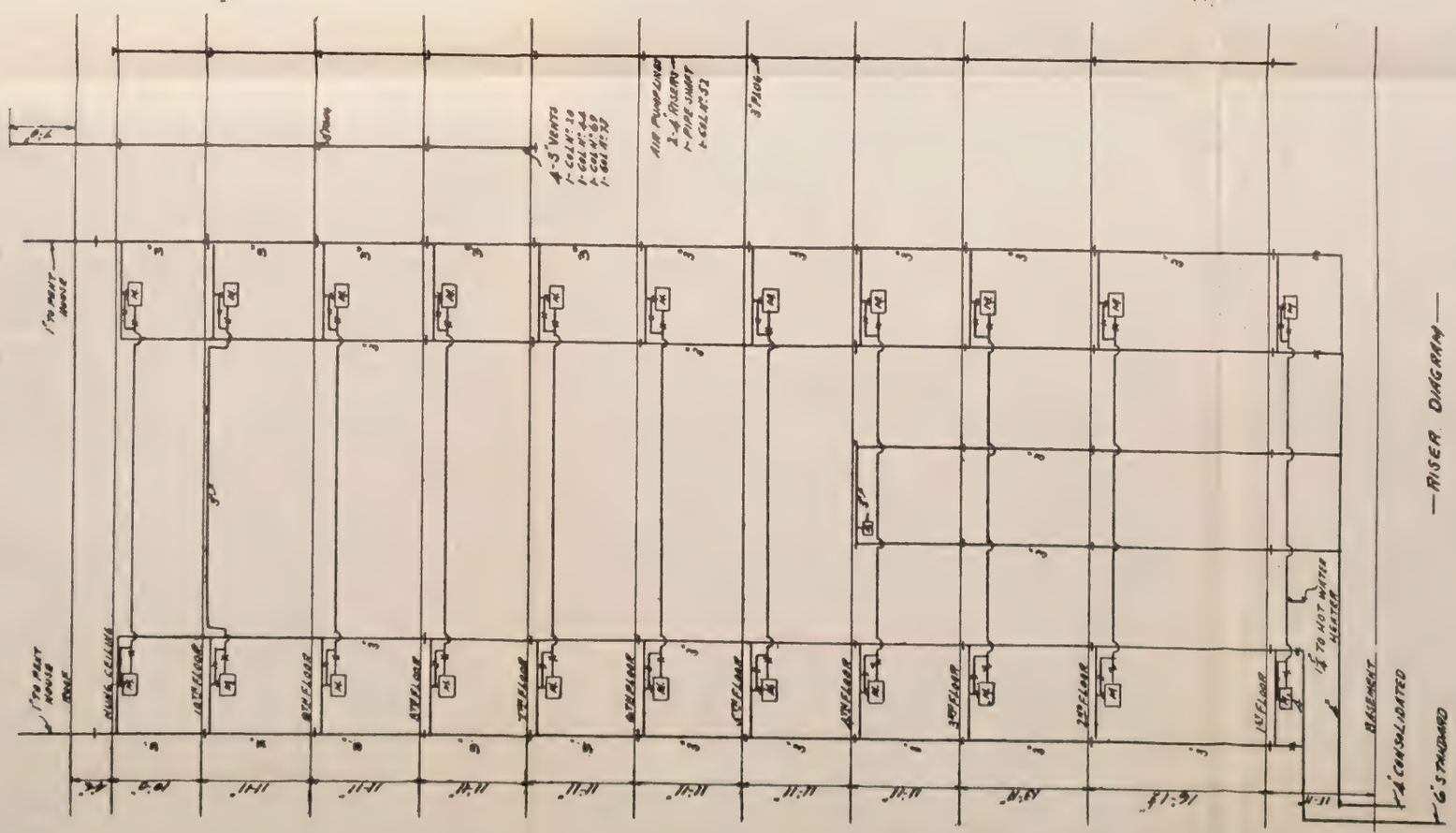
No Partitions shown on this plan have been built except those enclosing stairs, Elevators & Vent Shafts.



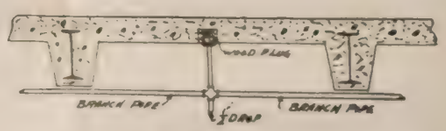
—TYPICAL FLOOR—



—CROSS SECTION—

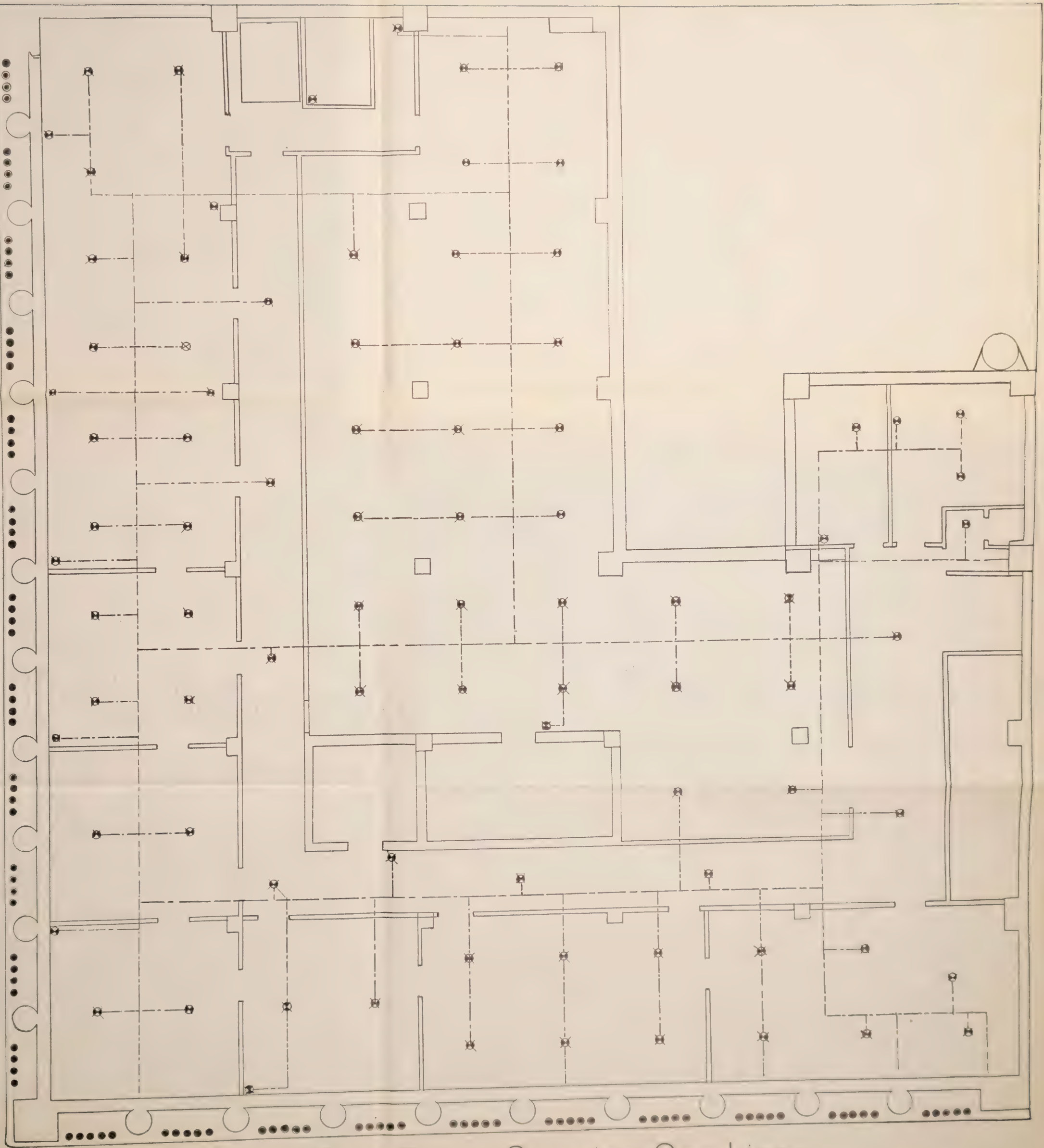


—RISER DIAGRAM—

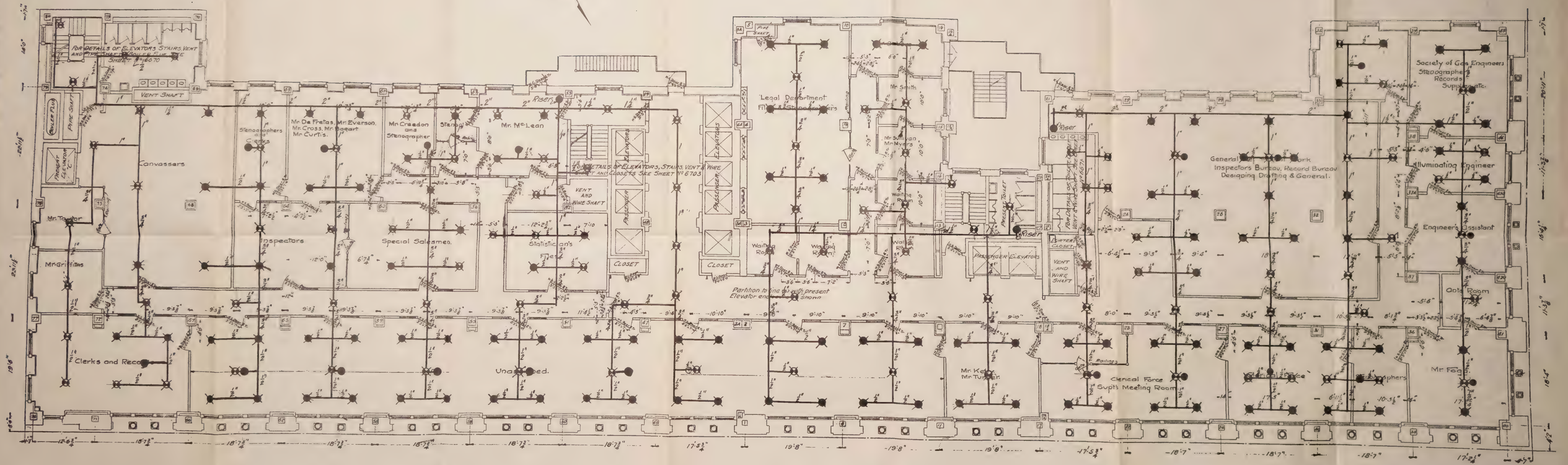


— DETAIL OF PIPE SUPPORT —

NOTE ½" DROP IN CENTER OF EACH BAY ARCH TO BE DRILLED AND PLUGGED AND NIPPLE CARRIED UP AND FASTENED BY MEANS OF DROP FITTINGS TO PLUG BY 2 SCREWS AS PER DETAIL PROVIDE CROSSES FOR RISERS AT LEVEL OF BOTTOM OF GIRDER WITH FULL SIZE BRANCHES PLUGGED



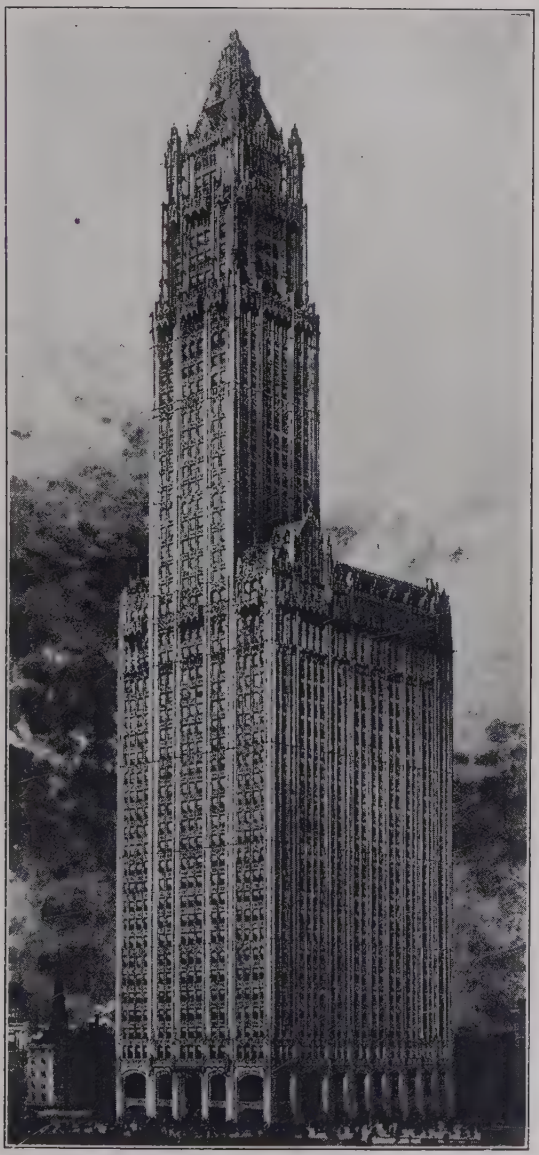
Ninth Floor Plan. Showing Gas Lines.



Key

- ⊠ Indicates combination outlet bracket
- ■ " gas outlet only
- ● " floor box

18th floor floor boxes are to be connected with 12" piping to 12th floor lighting.
Floor boxes shown on this plan are for 18th floor.



No. 1.—The world's tallest building piped for gas.

No. 2.—A modern office building. Piped throughout for gas for light, fuel and power.

No. 3.—A modern transient hotel. Piped for gas. Gas used in every kitchen in this building.

No. 4.—A modern loft building. Piped throughout for gas; using gas for light, fuel and power.

Mr. Fogg: This is a Committee report prepared by five members, and a number of other gentlemen have been of help, although their names do not appear on the Committee list.

Its primary object is to bring before the gas industry the need for aggressive action in urging the piping of large buildings for gas.

(Mr. Fogg read an abstract of this report.)

THE CHAIRMAN: Gentlemen, you have heard this report. It stands before you as a monument to this Committee. I only wish that committees were eligible for the Beal medal, because I am very sure this report would give everybody else a pretty close run for their money.

Now, I would like to have the discussion which this report warrants. I know it is very long, but it is long because it is very complete, and therefore I would like to have everybody show they are sufficiently interested in this work to get up on their feet and say something about it.

MR. E. C. JONES (San Francisco): I wish to compliment this Committee for the splendid work it has done on a subject that is very vital to us as gas men. In San Francisco, we had a peculiar experience with piping of large buildings several years ago, before the fire, which practically remedied the trouble automatically. One of the largest and first department stores in San Francisco was constructed of reinforced concrete and steel and not piped for gas. The owner and occupant of the building spurned gas as being old fashioned. I appealed to him to no effect, but one Saturday night the current went off all over San Francisco, with the result that nearly every till in this department store was tapped. It happened to be on what we call the south of Market Street, and evidently there were dishonest people there and they simply gathered in the Saturday night receipts. The occupant of the store came to me Sunday morning to see if I could pipe his building for gas before he opened Monday morning, and I explained to him the futility of trying to down gas; that it was the fuel of the future, the illuminant of the present and future. So he piped his department store and found the use of gas so economical that he got more light for less money, and he is still using gas in his store.

There is one matter I think has been overlooked in the general conclusions of the report, and that is the education of the public in the use of gas. Of course, that is being splendidly done by the National Commercial Gas Association,

through the extensive advertising they are doing. It is very commendable work, because we must sell our gas; it does not do us any good to have full gas holders if we cannot dispose of the product. But I believe that in the introduction of improved gas appliances for room heating and hot water heating, we should so educate the public in the use of these appliances and their economical use—where we touch a man's pocketbook, we get very close to his heart—that the public will insist upon having gas in all office buildings and other structures where architects attempt, on account of bother, to leave out gas pipes. It is rather a nuisance in modern buildings to put in gas pipes, but if the tenant insists upon the use of gas for heating his room and for lighting, then the architect must pipe the building, and the owner will not be able to rent his building unless he has gas in every room. With the advent of surface combustion, I believe we are going to enter the field of heating so that it will not be a question of whether large buildings will be piped for gas, but it will be a question of providing for very large pipes in large buildings. As an illustration of the piping of large buildings, every structure in the grounds of the Panama-Pacific Exposition is piped for gas, all the palaces, the foreign and state buildings, and even the kiosks are piped for gas, and every kiosk on the grounds has a gas arc. In our concession district, gas is used almost exclusively. In one little concession there are 110 gas arcs. As a gas man, of course, I never have divided my devotion. I am solely a gas man and never can be anything else. I know nothing else. My belief, my faith in gas is so strong that nothing can shake it. I only wish that every man here felt towards gas as I do. (Loud applause.)

Mr. R. R. Young (Newark): The Chairman brought up the subject of the apparent discrimination by the Board of Fire Underwriters against gas companies. Does the Institute or the Commercial Association make it a practice to have an official representative at all of those meetings? The National Electric Light Association does this, and they follow the work

of the Underwriters Association very closely to see that they are not discriminated against.

THE CHAIRMAN: There was a representative attending that convention in Chicago, and the Secretary of the American Gas Institute was there as a representative, and the American Gas Institute is a company member of the National Fire Protection Association.

MR. R. R. YOUNG: I would like to ask Mr. Fogg if he could give us the cost of the electric ignition systems compared to the total cost of piping the building. It will give us information which could be used by other companies when advocating the piping of office buildings for lighting and fuel purposes. The Consolidated Gas Company of New York has an electric ignition system installed throughout their buildings, and it would be valuable information if Mr. Fogg would give us the type of the ignition system in use and whether it has proven satisfactory.

For the benefit of the members present, I would ask the Committee to give us a few of the modern office buildings that are piped for gas lighting and where gas is being used for this purpose. We all know that it is most difficult to get an office building piped for gas. We should see that the building is first piped for fuel purposes, then follow this up with the arguments on gas for illumination purposes. I think if we can get the building piped for lighting purposes, it would be necessary to put the building on a maintenance plan.

I notice on page 1431, where it shows the comparative costs of electric and gas lighting, that the prices quoted there for tungsten lamps are not correct. At the start they say that the cost of a tungsten lamp is $1. That may be the list price of the lamp, but I do not think they have ever been $1. At the present time, 60-watt lamps are quoted by most companies at cost, this being about 21 or 22 cents. I think it also gives the impression that all renewals of tungsten lamps are free. In a number of towns, tungsten lamps of 60-watt size and upward are renewed free of charge, and in one city the renewal

charge for a 40-watt lamp is 12 cents, 20-watt lamp 14 cents, 10-watt lamp 24 cents.

There is another point in the comparison made, on which I do not think we should deceive ourselves. In the relative cost of electric current and gas for large buildings, the average cost per kilowatt hour on a large consumption would drop faster than the rate of gas per cubic foot. For instance, in many office buildings, say eight, ten or twelve floors, the average rate for electric current is from four to about six cents per kilowatt hour, or less than half the base rate, whereas the average gas rate per cubic foot would be only 75 per cent. of the base rate, and in some towns no reduction at all.

Mr. W. Cullen Morris (New York): In the report, Mr. Fogg lays particular stress upon the effort which should be exerted with the architect, contractors, and plumbers interested in the installation of piping in buildings. I think that course is very wise, but it is necessary in the first place to establish the demand, and in establishing the demand for any product, it is necessary that your product shall be superior to a competing product. The trouble with gas men is the selling agent—I think that is hurting them more than anything else—the failure to follow up the sale, either of their product or the utensil which is using that product. Until that has been done, so that the consumer is thoroughly satisfied that after he buys an appliance, the seller is going to see that it works, we are going to have difficulty in establishing a demand in such buildings as are discussed in this paper. There is no question that the service can be as good as that given by any electric company. In a building both Mr. Fogg and myself have a great deal of familiarity with, we have maintained a gas lighting system now for a period of three years, with, I think, practically as good service and as easily manipulated service as any electrically lighted building in New York. In Mr. Fogg's paper, he refers to the cost of piping the new Consolidated Gas Building, and the cost appears high. If figured on the cost per outlet given in Mr. Fogg's paper, that is, 2,500

outlets for an expenditure of $22,000, it makes the cost per outlet somewhat over $10. I wish to explain this so that the paper will not give a wrong impression to anybody figuring on the cost of gas installation. The building was piped throughout the twenty floors, so that outlets could be taken on any of the floors as required. Certain of these floors are occupied by the affiliated electric companies, and are wired for electricity. The total number of outlets available from the piping approximates 5,000, and reducing the cost per outlet from about $10.50 down to about $5.50, which is normal. The relation of percentage of cost to the total cost would be in a normal building between ½ and ⅝ of 1 per cent. There are other reasons for high cost in this building. On the first floor of the building and in the basement, there were numerous outlets placed so that gas appliances could be connected from the baseboards at intervals of every few feet, and also from the center of the floor panels and from the column bases, all of which would not enter into a normal lighting condition. I am going to answer for Mr. Fogg, if I may, the question in regard to the relation of cost between gas and electrical installation of lighting in buildings. In this same particular building, the relation is about one to five, the electrical installation costing about five times the gas installation.

Mr. L. R. Dutton (Wyncote, Pa.): With the other speakers, I feel that too much credit cannot be given the Committee for the comprehensive report for supplying piping not only to large buildings, but also to the average home.

There seems to be a peculiar indifference among gas companies relative to the piping question. There is a remarkable lack of insistence on providing adequate piping for new buildings. We devote a large part of our attention to selling appliances, but should see first that buildings are fitted to have them connected easily.

When preparation of the booklet, "Gas Equipment of the Home," was begun, the main hope was that the booklet might

have as its central object, piping of buildings and information of that character.

After the booklet committee had several meetings and had endeavored to secure information from gas companies in various cities of our country, both large and small, it was obliged to abandon the thought of preparing a booklet that would contain a standard piping schedule for the average home.

Probably not over one-half of the companies represented in the cities to which we applied for piping schedules, were able to supply a schedule revised by them as recently as 10 or 15 years ago. Some of them admitted they had no piping schedule, but were anxious to have a modern one. Companies in other large cities replied by sending us piping schedules, but they were in the nature of city ordinances, probably prepared not by the gas companies, but by plumbers' associations in other cities. Some of these schedules did not contain adequate sizes for modern conditions and had no provision for proper inspection of the pipe when installed.

When we consulted the architects as to their sources of information as to piping, the invariable answer was they had given the matter no attention unless the gas companies had provided them with a schedule which they should submit to plumbers.

Our Committee saw the difficulty that confronted it, and this was further emphasized by the fact that some of the gas companies whom we thought needed a booklet of the nature proposed, stated that if we prepared and issued the booklet and inserted a piping schedule, we need not expect any sales of the booklet to their companies. The only thing we felt could be done with safety was to submit the schedule of piping endorsed by the American Gas Light Association 16 years ago, and in placing this schedule in the last pages of our booklet, a provision was made so that this schedule would not stop the sale of the book or its usefulness when circulated among architects and owners. The pages containing the piping schedule

were perforated to permit this section being torn out of the book in locations where it did not conform to local plumbing ordinances.

When such a condition exists with reference to uniformity of piping of small buildings, we are impressed with the value of the report that has been submitted by this Committee, covering in a comprehensive manner for the gas industry, the arguments in favor of adequately piping all new buildings.

One of the suggestions that has been made by two of the speakers, I think should be given attention. Their remarks seem to center around the requirements of tenants of new buildings for proper gas piping in buildings after completion. If we take that suggestion and think back a little, we will see that it is getting the cart before the horse. It is rather late to consider piping after waiting until the owner has completed the building and is endeavoring to secure a tenant. The desirable tenant may be he who wants gas service, and to provide for him it is necessary to get started earlier in the game and connect with the architect. The economical question of piping would naturally appeal to the owner while building, if it is placed up to him in the proper manner; but we must go further, and convince the architect when he is preparing plans.

Architects tell us very plainly that representatives of gas companies generally neglect to impress them with the necessity for piping or of submitting modern specifications for doing so. Architects have data furnished them by the manufacturers of heating appliances, wire specifications by electrical companies, and engineering data which they need for other facilities which go into a building, but the piping question seems to be ignored. It seems to have been neglected by the gas companies, and so much more is the responsibility on us because we assume more than other companies to look after this work ourselves. We assume not only to prepare a schedule for piping, but in most instances to take the piping contract, and while in some cities the matter is given the attention it desires, in many instances the companies are failing very much in this respect.

Before closing, I want to call particular attention to the "arguments or reasons" for the use of gas given on page 1359 of the report. I regret that in the printing of the pamphlet, these arguments are not so paragraphed with captions that each argument might be emphasized. These arguments should be very useful for the salesman or representative of the gas company in his quest for orders for new buildings that should be piped.

Mr. Norman Macbeth (New York): There are a few points I would like to refer to in this report. On the rules for piping, my experience has been as Mr. Dutton states, that the present rules were prepared many years ago. They are on the flat flame basis when it comes to lighting. If you take a window lighting proposition and put in, say, ten 3½ cu. ft. burners, the usual rules will require 1-in. pipe for a 55-ft. run, 1¼-in. for 105-ft., or 1½-in. for 250-ft. The same rules, if they would permit these lamps to be rated at their capacity, would permit a 1-in. run of 210 ft. or 1¼-in. pipe for a 670-ft. run, an enormous cost difference due solely to indifference to present practice.

Many of the electric central stations would be no better off to-day than the gas companies, were it not for the electrical contractor's co-operation. There is very little dealer and plumber co-operation with gas companies, at least so far as my information has extended. I have heard of more instances of antagonism than of co-operation.

The report, covering as it does the piping of large buildings, will do a wonderful amount of good, provided the men who are consulted by owners of large buildings can put over the justification required by the owner before considering an expense, even so slight as this would be. I would like to know how may gas managers throughout the country have, and would use, convincing arguments under such circumstances. Personally, I know many who would say "We don't want the business."

There is also the very pertinent question of costs referred

to by Mr. Young. Gas companies can no more get their highest retail rates for lighting in large buildings than they can for street lighting. Neither can the electric companies—but they do not expect so much of the impossible. Central station electric rates for large buildings are much lower than their highest retail rate. Then there is also the competition of the isolated plant. In an article a short time ago, in a publication in touch with the field, it was shown that of all the large buildings appearing in the usual "sky line of New York" picture, a very small number purchase their power, the majority having their own plants. These buildings are mostly heated with exhaust steam, and you are aware that under these conditions, it is difficult, in apportioning charges, to determine whether the steam for heat, or the by-product electrical energy should be supplied free. The charge, whatever it may be, would not make dollar gas look at all favorable.

That is one of the considerations that gas companies will have to face. A sliding scale rate, such as many companies give on industrial business, might help, but unsupported sentimental reasons will not hold for long, if at all.

As a further light on this question of large buildings, there was a recent hearing of the commission on the height of buildings in the city of New York. The meeting was held on the eleventh floor of a building down on Broadway opposite where the Equitable wreck stood at that time. The sky line was on a line with the window sill. The meeting was called at 3 o'clock in the afternoon, and the shades were all down, and the artificial light (electric) was turned on in that room. I was among the first there, and noting the situation, measured up the room, and checked up the energy cost for the adequate lighting in use. During the hearing, I called attention to this preference for artificial light when there was an abundance of daylight available. The shades were run up, and the electric light switched off, and a vote was taken on the preference for daylight or artificial light. The majority voted for the artificial light. The point I desired to make referred to the low

cost of that artificial light, declared to be more satisfactory in the room than daylight. If used for 10 hours a day, 300 days a year, would be exactly 2 per cent. of the rental rate per square foot in that particular office, so that artificial light is indeed a very low priced proposition.

Mr. Fogg mentioned the use of Dodge reports. I heard of an amusing incident a short time ago that occurred with a gas company using the Dodge reports. As a result of systematically following up these reports, they fitted up a building with arc lamps next door to the gas company office. This firm had been in business for 20 years at the same location, but it required a Dodge report to arouse the gas company's interest in the lighting equipment of their next door neighbor, who was making some slight changes in the interior of his building.

It seems to me gas companies can get the strongest kind of an argument for owners and architects as to why buildings and houses should be piped for gas if they can go to either of these interested parties and say, "Gentlemen, this is why buildings should be piped for gas. This is what we are now, and have for years, been doing with houses that are piped—here is what our users say about the excellence of our service." If you can do that, can show the overflowing satisfaction of present consumers whose installations have been under your supervision, and for whom you have been rendering complaint-proof service, then you will have an unbeatable argument as to why houses should be piped. If the man you are trying to interest sympathetically in gas piping can go through his own town, and find thousands of dollars of unused piping investments, installations that the gas company neither know of, nor care about, then you will have trouble in spreading your particular gospel of "Tie up your money in gas piping, you may need our services some day."

I recall a very similar incident with an electric company a few years ago. I was asked to go to a small city to assist in having gas lighting taken out of a new building. It was a

six-story concrete structure, with wiring throughout all the different floors. The electric man had conferred effectively with the owner and the architect, and gas piping had been omitted. Just about the time the building was completed, a new commercial gas man was transferred to this district, and being too late on the scene to do anything with either the owner or the architect, he went among the tenants. His plea was, that a serious oversight had been committed, that efficient modern gas lighting was something to be desired, and all he wanted was an opportunity to make good his claims. "All I want is the privilege of coming in here and properly lighting these floors as I think they ought to be lighted. I will tell you what it costs. After I have made good on my recommendation, you will pay for the lamps, piping and maintenance, and continue the service; but if I have not made good, I will take out the material installed, and you will be at no expense for the experience."

I was asked in by the electric company to prevail on these tenants to use electric light. Now, the electric company had done all this committee asks you to do; they had gotten to the owner and to the architect; the building was wired as desired, but the final step had not been taken,—the tenants had not been sold and signed up. That the gas man attended to, while the electric man waited in his office for them to come to him. As an electric man, there was nothing for me to do but to acknowledge the omission, and explain that we were ready and willing to supply adequate and satisfactory electric service just as soon as any of the tenants in this building would give us an opportunity. That was three years ago, and gas lamps still provide the lighting service in that building. The piping and lamps have been paid for, and maintenance charges have been regularly met.

The gas man always makes a strong play on piping buildings for emergency lighting. That is going to be taken away from you. There is a very excellent storage battery proposition coming on the market, where they simply run a feed wire

around the building with storage cells attached at convenient points, each to a lamp, and if there should be an interruption to the service, the lamps would be automatically lighted and supplied from the individual batteries. If desired, the lamp and the battery may be lifted from the wall support, and carried around as a hand lamp for several hours. This kind of emergency service is effective, and is not expensive either to install or maintain.

As far as public buildings are concerned, I believe the Treasury Department in charge of Post Office and other public buildings has ruled against the piping of buildings for gas lighting, probably largely due to the difficulty experienced in securing proper maintenance of the gas lighting equipment.

I would like to ask how long the American Gas Institute representative has been attending the meetings of the Underwriters' Association. I had a case here in New York a few years ago when the regulation went into effect, requiring that we put above any gas lamp where the ceiling was within 3 ft. of the top of the lamp, a large disk of heavy asbestos. There was no question about the size of the lamp, whether a ½ cu. ft. per hour, or 20, 50 or 100 cu. ft. per hour. I finally had an interview with the Undewriters' inspector in charge. It was not long before I realized both of us were full of conversation with a dearth of actual information. As a result, I started a series of tests that ran for six months. These reports were turned over to the Underwriters' Board here in New York, and about that time I was required to give less time to gas lighting, and I do not know what was the final outcome.

We had a factory investigating committee that worked here in New York a long time among the sweat shop, skirt and shirt waist industries. These inspectors are going around noting the unsanitary conditions and so forth, and, among other things, they reported on glare. In practically every place where there was a gas lamp, whether it was a mantle burner or open flame or completely inclosed with reflector, it was reported as "glare." All electric lamps, whether bare or

not, were reported as "no glare." Every gas lamp was "glare." That was the way they had been taught. About the only way such matters can be kept straight is for gas companies to take a broader interest in the affairs of their city. Have representatives whose business it shall be to keep in touch with these various committees and associations.

Mr. Morris brought out the point that the Consolidated Gas Company has maintained efficient satisfactory gas lighting in a large building for three years. I wonder if costs on that building have been published. It is too bad, where information of that kind is available, that it is not put out. If the costs are favorable, the figures will help many a weak gas man, and if they are not favorable, they would undoubtedly prevent misrepresentation.

On the question of costs of piping versus wiring, all the buildings to-day are piped for electricity, and then, into the pipes or conduit they draw the wires. It is a certainty that the costs are less for gas piping than for wiring. But it is not a question of cost alone, but rather the overall cost for a given service.

Just in closing, I want to repeat the point I endeavored to bring out first, that if the gas companies can go to architects and owners in their own town, and tell them of creditable service now being rendered to houses that are now piped, and the satisfaction these consumers are getting with gas lighting and gas for fuel, you will have the very best argument that has ever been brought out as to why new buildings should be piped. (Applause.)

Mr. G. R. Althen (Baltimore): The report of the Committee in handling a very vital subject, bears a message which must undoubtedly create an impression on every progressive gas company, as it points the way to a new goal for achievement over a field which permits of greater development. Any movement which tends to promote the installation of gas-piping in large buildings, should meet with hearty support, and the recommendations as set forth by the Committee which

have this end in view, deserve careful consideration. We must, however, not overlook the difficulties which we are certain to meet in the task. The builder seeing, perhaps, little immediate prospect for any extensive use of gas in his building, is quite prone to contract for the gaspiping work at the lowest possible cost, and it becomes exceedingly difficult for the Commercial man, upon whom the burden of the task falls, to convince him that an additional expenditure is desirable. I refer especially to the modern office building, of which the nature of its future tenancy is not definitely known. The possibility of the office room being occupied by doctors, dentists, laboratories, lunchrooms, etc., complicates the problem, and the same principle might apply in the loft building where the requirement may range anywhere from supplying a small bunsen flame to a high power gas engine. The prime consideration seems to be the necessity of educating the architect in the uses of gas for light, heat and power. This should be the first step of a concerted plan of action, which, if followed along conservative lines, must create a demand as a natural sequence.

To be effective, a well defined plan must be conservative in its conception, and accordingly our representatives must exercise care that their predictions do not lack ample verification.

A telling argument might consist in pointing out to the architect the mistakes of others, or it might prove well to cite the well advised plans of others which have resulted profitably.

In Baltimore, we have encountered a number of large buildings which were extensively yet inadequately piped, one notable example being the case of a six-story building with 1-in. risers and ½-in. running lines of 90 ft. to the length. In another case, our company was asked to bid on an installation for the Government, where the specification called for pipe a size smaller than that required to deliver the needed supply.

We are frequently called upon to pipe for a heater, a room

in an office building in which there is only one existing outlet, and that in the center of the ceiling.

Another difficulty we have had to contend with in providing service for a tenant in a loft building which has not been adequately piped, is in securing the permission of other tenants to run the piping through their rooms. This condition has often created no end of inconvenience and delay before the difficulty is finally adjusted.

Another disadvantage which should not be lost sight of in piping after erection, is the care the workmen must exercise in running pipe lines over the heads of those employed in the building and also over moving machinery. The safeguards and precaution necessary to avoid possible accidents runs the cost of installation up considerably.

We can also bear testimony to the arguments advanced in the report in saying that we have seen a large building erected for manufacturing purposes, with no provisions made for gaspiping, and in which case it was subsequently necessary to cut through concrete walls and drill girders at considerable expense. It seems to me, therefore, that our interests could best be subserved if our energies were directed toward convincing the architect, owner or other parties concerned, that attention to gaspiping detail is worthy of more than secondary importance and should stand out as one of the prominent features of the building plans.

The movement which has been fostered by the Committee, it is hoped, should meet with the earnest co-operation of the gas industry, on the ground, alone, that the soundness of its recommendations are brought home forcibly to us in every day application.

Mr. A. A. Treadway (Detroit): I would like to ask Mr. Macbeth when this order was issued from the Treasury Department limiting the further use of gas for lighting?

Mr. W. R. Addicks (New York): The report of the Committee on Piping Large Buildings for Gas is an excellent one and I congratulate the Committee on its success, and com-

mend the subject matter to the serious study of the members of the Institute. I should expect to see further communications in the *Gas Institute News* on this subject in the next 12 months. Many questions may have to be asked and the agitation of the subject in this manner will be healthful.

It might be well to consider the reasons for omitting gas piping from buildings. My own experience leads me to believe that one of the chief reasons, at least in Boston, was an explosion that occurred in a large fireproof building on State Street in the late eighties, I think. Electric wires were thoughtlessly run in contact with gas pipes, with which this tall building was equipped; a short circuit melted a hole in a gas pipe on one of the upper floors, which permitted gas to fill the interstices of the hollow tile floor, and a second short circuit ignited the mixture, which destroyed a section of the floor. The chief culprit did not receive his full deserts. Modern practice would insure entire freedom from a repetition of that event.

The architect of a very large hotel, more than ten stories high and 200 ft. square, told me that all the gas pipes he had installed for fireplace heating had to be abandoned after a few years use because of corrosion. The material surrounding the pipes, I understand to have been loose cinders. With water leaks, I should assume that this method of construction, which I do not understand is now used, would seem objectionable.

We must see that proper insulation be secured from the electric installations, and that possible corrosion be eliminated. Cinder concrete has doubtlessly entirely supplanted loose cinders. I have always combatted this elimination of gas pipes, which was acquiesced in, if not encouraged, by our electric light friends.

But to-day the developments of gas for fuel has impressed all men to such an extent that I apprehend little opposition from any force other than "General Expense," and your Committee has clearly shown how small that force should be.

If the Committee had seen fit to make corresponding figures for the electric wiring and for modern plumbing, it is my impression that the low cost of gaspiping would have been still more impressive when placed in comparison.

In my view, architects who continue to ignore the demands for gaspiping in large buildings, for any reason that seems fair and satisfactory to them, will be sacrificing the interests of the owners, both present and, to a larger degree, future owners, by saving at the spigot and later losing at the bunghole. I have been asked to discuss this paper and would be glad to add to what I have said except for your time consumed.

I would like to emphasize the necessity for a system of follow-up, and having had experience in formulating such a system, I would emphasize its necessity as an absolute essential.

Securing the co-operation of the plumber and contracting builder is of equal importance to the architect, but it is perhaps more difficult to properly arrange for.

The demand for gas at all locations in all buildings must permeate the entire community, and its necessity generally accepted, before the problem becomes easy.

It is a fact that many apartment house occupants desire not only full facilities in the kitchen and fireplaces, but would be glad to have gas light in the living rooms because of the superiority of gas as a reading agent.

Mr. F. W. Schmidt (Jersey City): This report is applicable to small as well as large buildings, and it is a very instructive message to gas companies. It puts the matter squarely up to us to see that architects, owners and builders are properly instructed in the use and advantages of our commodity. The report shows us the manifold advantages of gas from almost every conceivable point of view. It is replete with instruction and suggestions, together with plates and charts showing installations, and a copy of this report placed in the hands of our New Business Department and its repre-

sentatives, will be an exceptionally concise and valuable aid to them in presenting suitable arguments to counteract excuses that might be offered by any one contemplating the omission of suitable piping from his buildings.

Mr. J. P. Hanlan (Newark): The first conclusion all of us must come to in regard to the piping of large, or small buildings for that matter, is that the fault for their not being piped can be directly traced to the gas companies themselves, and but indirectly to architects or owners of the buildings, since both of the latter parties are willing to incur expense or make provisions for the use of appliances or commodities that would add to the comfort or welfare of their tenants, or which might be necessary in the transaction of their business.

It is a big enough job for the manager of a gas company to see the architect or owner, and to have prospective tenants of large buildings interviewed, if there are any questions about such large buildings not being piped for gas.

It is also within the province of this and other associations, to take concerted action that would tend to focus more thought and attention on this subject.

It is not too late to begin efforts now, because every building which is not now equipped with gaspiping has tenants which have many times felt the need of gas in some way or another, and because of this fact, owners have been forced to install piping subsequently to the completion of their buildings, owing to this demand on the part of their tenants. This should be one of the strongest arguments brought to bear on architects and others interested in new building construction.

We frequently see advertisements which read as follows: "Heat, water, light and power supply." Each of us, no doubt, could bring about the addition to this sentence: "City gas is available for all purposes."

The Chairman: I will have to close the discussion by asking Mr. Fogg to add anything which he wishes to say.

Mr. Fogg: I have nothing to add. I will attempt to reply to those specific questions that I have been able to keep track

of. Please have it in mind, however, that this is a committee report and I cannot hope to reply properly for the Committee, but only from my own standpoint.

Mr. Jones brings up the question of the necessity of educating the public—that is conceded at first glance—we have to do it in order to survive. We are all more or less awake to it. and in our individual situations we are doing something, but I do not believe that any of us are doing quite enough.

Mr. Young's question, as to the relative cost of piping for gas and wiring for electricity, has been answered by Mr. Morris. He asks for the details and costs of the ignition system used in our building. I am sorry that I am not in a position to give them out at the present time; they will, I hope, be available before very long to anyone who is interested.

Mr. Young asks further for cases of modern buildings that have been piped for gas and where gas is in use. In each of the buildings illustrated in the report, there are piping systems and gas is used,—the Woolworth Building for example, the McAlpin Hotel, and, needless to say, the Consolidated Gas Building. It would make a rather long list to enumerate the buildings in New York of the class under discussion, in which there are piping systems and in which gas is being used. I do not want to be understood as saying that they are fully piped throughout and using gas for all purposes. When I say the McAlpin, for example, I do not mean to say that gas is used for illumination and everything else—I wish that was the case. There is, I believe, a service kitchen using gas on every floor and the main restaurants are served by gas kitchens Gas can be used on every floor of the Woolworth Building, for the piping system is there, from top to bottom, and the restaurant on the top floor is served by a gas kitchen.

Mr. Young questions the accuracy of the cost of electric renewals given in the Appendix, Section "E." These figures are not the cost per lamp, but the estimated cost of renewals for a period of one year.

Mr. Morris has brought out the point that the cost of in-

stalling a piping system in one case is high—approximating 1 per cent. of the building. It is high and the Committee knew it, but we particularly wanted to state it as a maximum, or an extreme outside figure. As a matter of fact, in this particular case, the cost given by us includes altering and remodeling the piping system originally installed in the first twelve-story section of the building which was erected and occupied, before the present structure was commenced. Had it been a case of new construction throughout, the cost of the complete gas piping system (and it was a most comprehensive one) would have approximated ⅔ of 1 per cent. of the cost of the building.

I am not going to try to answer Mr. Macbeth, because, in the long run, I think he justifies almost every statement that we have made. His criticisms are helpful and constructive, and his remarks bring very strongly home the fact that we often fail to apply our information to the practical solution of our problems. It is a direction in which we are lamentably weak at times.

The title of our illustration on the first page, "Why not Every Government and Public Building in the United States?" is aimed directly at the condition that Mr. Macbeth speaks of *i. e.*, the tendency toward the elimination of gaspiping from Government buildings, and it is a condition that is distinctly up to the gas industry to correct. The title is meant to be inspirational rather than to call for a definite answer, for I think that we all know the answer. So far as I know, there has been no definite ruling excluding gaspiping from Government buildings. There has been a tendency in that direction, but I think that no rule has yet been made, and I know that we do not want such a rule, either as regards government or any other class of buildings, nor need we fear anything of the sort if we get out actively and energetically and make a proper presentation of the facts.

The whole purpose of this report is to urge this kind of activity.

Mr. Macbeth: There is one point you should not overlook. The Public Library on Fifth Avenue was completed a few years ago. It was stated at the time that the wiring and lighting arrangements had gone through complete in accordance with specifications that were drawn 13 years before. It may take time to feel the effect of this ruling against piping, but in the meantime it is in effect, although perhaps not noted on structures now under way. There is perhaps one exception which may be considered in this Treasury Department matter; that is, it refers to the Government owned buildings. In many cities, sub-stations and post offices are rented, and in many instances, the owner of the building is required to furnish light and heat. You may be able to get to this man and secure a recognition of your service.

The Chairman: I wish to thank the Committee on Piping Large Buildings for Gas for the work it has done in this connection.

Mr. Fogg: Thank you very much, Mr. Chairman. I know the Committee will appreciate that.

The Chairman: The next item on our program is a report of the Committee on the Utilization of Gas Appliances. Mr. W. J. Serrill, of Philadelphia, is Chairman of this Committee, but as he is not present, I will ask Mr. G. S. Barrows, of Philadelphia, to take the floor and read the abstract of this report.

REPORT OF THE COMMITTEE ON THE UTILIZATION OF GAS APPLIANCES.

Section I.—Gas Range Specification.

The Standard Gas Range Specification is now 2 years old. Good progress is being made towards its general adoption. A reform of this nature cannot be expected to gain universal acceptance at once; it must advance step by step. Gas companies are urged to purchase only specification ranges. By so doing, they secure satisfied consumers and minimum com-

plaint expense; they uphold the two societies who have jointly adopted the specification; and they strengthen and fortify the gas industry. The marking of specification ranges mentioned below, will facilitate their general adoption.

Marking of Gas Ranges.

The question of marking gas ranges has been discussed not only by this committee, but also by the committee of the National Commercial Gas Association having this and similar matters in charge.

It has been suggested that tags be provided by the associations, which would be sold to the manufacturers at cost price, but because of the difficulty of inspection of the various appliances by the representatives of the associations, it seems that this plan is not in every way desirable.

It is not within the province of the Institute, in our opinion, to undertake to issue any such tag, badge or brand nor would it be justified in assuming the responsibility for the proper use of such a mark. Any purchaser of gas appliances can require this information of the manufacturer, and on the other hand, there is nothing to prevent any manufacturer from so marking his appliances by a tag, badge or any other means he may desire; indicating that the range is constructed in accordance with the specification. The Committee does not feel justified in making any definite recommendation, believing that it is a matter which should be left to the manufacturer to deal with as he may prefer.

The Committee, therefore, limits its action in this matter to the suggestion that, where it is desired to mark the ranges, the following form of expression be employed:

> "This range is guaranteed by the manufacturer to be constructed in accordance with the Gas Range Specification adopted by the American Gas Institute and the National Commercial Gas Association."

It is considered by the committee that such marking of ranges will bring to the manufacturers the advantages they

desire, and secure to the consumers protection against inferior appliances.

Gas Range Cocks.

A cock with a nut and lock nut in place of the ordinary tail screw, and having a metal handle instead of the porcelain or wooden handle commonly used, has been submitted to the committee. A series of tests extending over a period of more than a year, leads the committee to believe that the use of the nut and lock nut in place of the tail screw, is a highly desirable change, because of the ease with which the parts may be separated for inspection or adjustment. We believe that this construction should be specified in the future and that manufacturers should be urged to order these cocks for their future requirements, doing away with the present form of cock having a tail screw, at the earliest possible date.

Regarding the metal handle, it seems to the committee that appearance enters so largely into this question, that it would be inadvisable to specify the metal handle cock alone. We have therefore so drawn the wording of the proposed specification as to permit the use of the metal, porcelain, wooden, or composition handles.

Your Committee recommends that Clause 20 (p. 486, 1912 PROCEEDINGS) of the existing Specification be changed to read as follows:

> "(20) *Cocks and Valves.*—Ranges are to be equipped with either lever handle cocks or wheel handle valves as ordered. Cocks and valves are to be tested and required to remain tight and free from leaks under a pressure of three pounds per square inch.
>
> "*Cocks.*—Where cocks are used, they are to be of the type known as the 'Standard Gas Range Cock,' and to be supplied with either a wooden, composition, porcelain or metal handle as ordered. All details and dimensions of this cock are to be in strict accordance with the drawings which accompany, and are a part of, this specification. (See Figs. 1-3.)

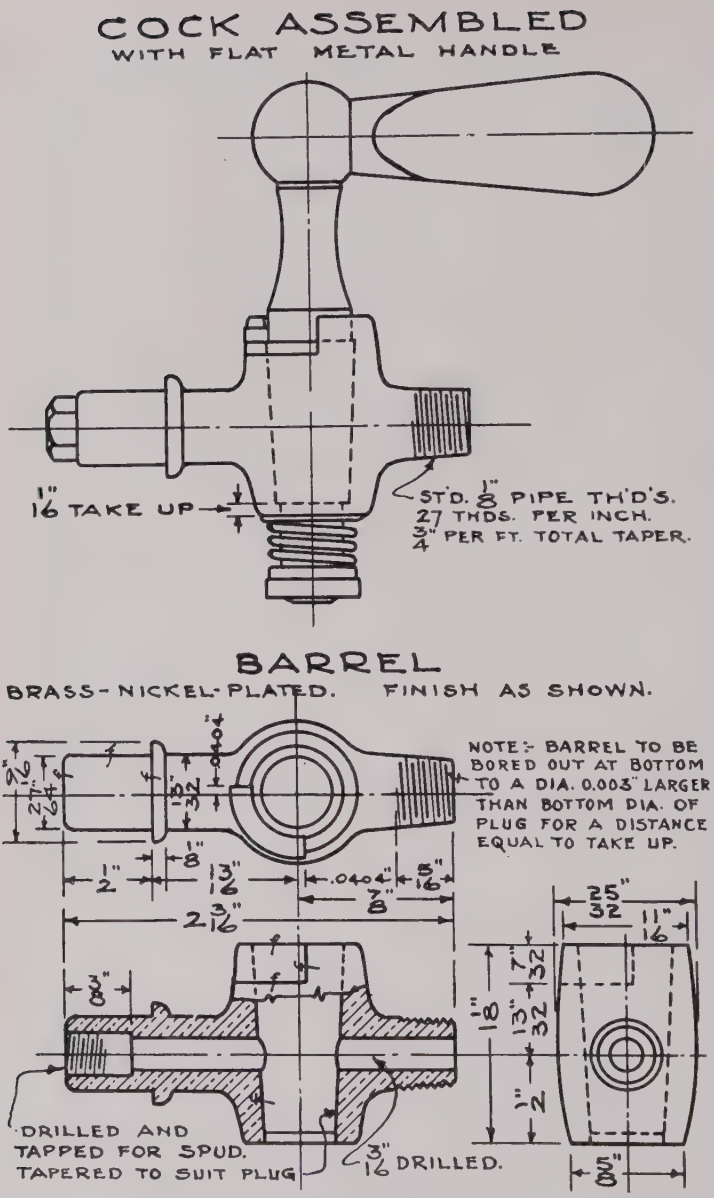


Fig. 1.—Standard cock. Page 1513.

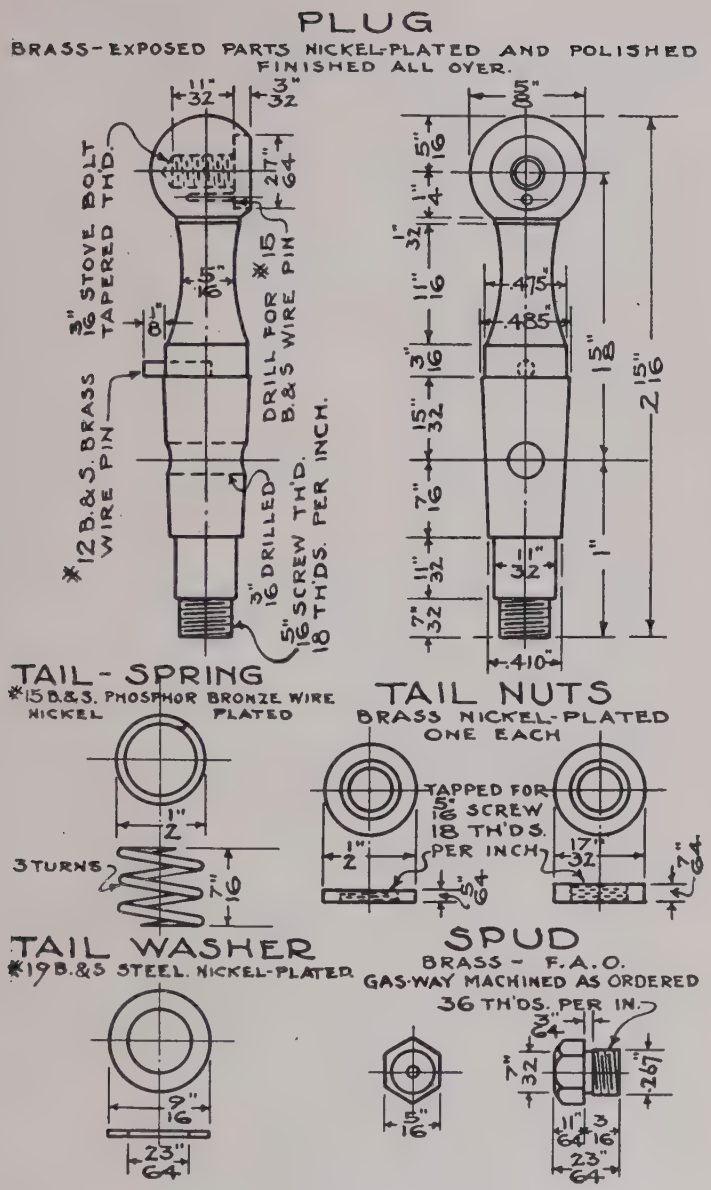


Fig. 2.—Standard cock. Page 1513.

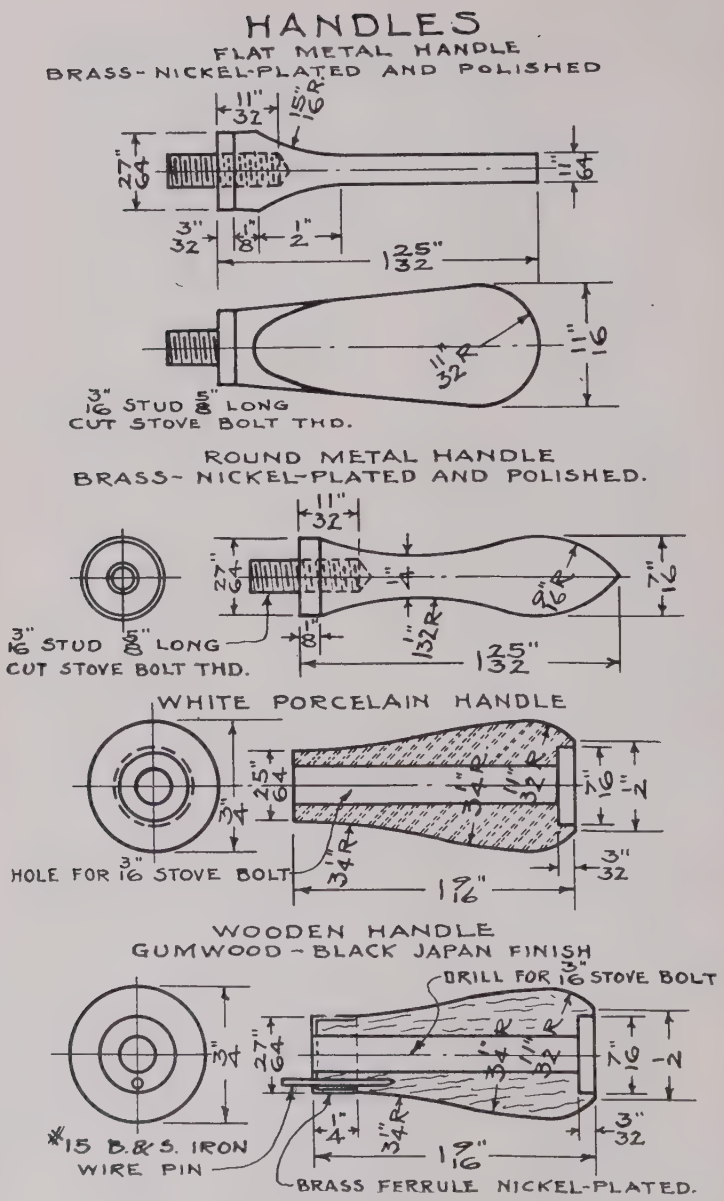


Fig. 3.—Standard cock. Page 1513.

"*Valves.*—Where valves are used, they are to be so constructed that the part carrying the gas nozzle or orifice and the part carrying the valve stem may be placed in the rail or manifold in such a way that there will be no chance for the valve stem and the nozzle to be out of alignment, and further, that the valve be so attached to the rail or manifold that it will not swing nor become displaced from its correct position, to the extent of interfering with the direct passage of the gas along the axis of the mixing tube of the burner."

It is not the intent of the specification to limit the Standard Gas Range Cock to the fixed orifice type. While this type of orifice is preferred and its use is recommended, the Committee recognizes the fact that, because of local conditions, some companies will prefer the adjustable orifice. The drawing which gives the details and dimensions of the Standard Cock, bears the following note:

"To be considered as complying with the specification, a cock equipped with an adjustable orifice must, in all other respects, be in accordance with the details and dimensions given above, departing only therefrom in the design of the orifice or burner end and in no way impairing the interchangeability of either type of cock with the same burner."

In this case, as in others, this Committee is working in harmony with the Committee of the National Commercial Gas Association.

Notes applying to Figs. 1-3.

1. Plugs to be ground in barrels.
2. All exposed parts of cock to be nickel plated.
3. With wood, composition or porcelain handles a standard $1^{3}/_{4}$-in. x $^{3}/_{16}$-in. stove bolt is to be used. The hole in the head of the plug for the $^{3}/_{16}$-in. stove bolt to have tapered instead of straight threads so that in assembling the cock this bolt will be held tightly in place.

4. To be no shoulder at end of $^1/_8$-in. pipe thread, but to be gradually tapered as shown.
5. All cocks to have a distinguishing mark, cast in an inconspicuous place, to be submitted for approval.
6. The brass used in these cocks must conform as closely as possible to the following mixture:

Copper	68 per cent.
Zinc	19 per cent.
Lead	12 per cent.
Tin	1 per cent.

7. To be considered as complying with the specification, a cock equipped with an adjustable orifice must, in all other respects, be in accordance with the details and dimensions shown, departing therefrom only in the design of the orifice or burner end and in no way impairing the interchangeability of either type of cock with the same burner.

Gas Range Valves.

An examination of valves used by most of the manufacturers of gas ranges in the country, shows that with but one or two exceptions the general construction of the various valves is quite similar.

In one type of valve the part with the screw thread for the adjustment of the valve and the nozzle or gas orifice are built up as a unit and either inserted in the gas rail by drilling the rail or by connecting to the gas rail as a manifold fitting.

In the other type valve, the part with the screw thread for the regulation of the valve and the part with the nozzle, are made as two separate pieces and applied separately to the gas rail.

In the former case there is but little chance that the valve stem and nozzle will be out of alignment, while in the latter case, it is not only possible, but probable, that some difficulty will be experienced, because the stem may not be on the true axis of the nozzle.

The members of the committee believe that the former construction is preferable. As there are such a large number of differently designed valves on the market at the present time, it does not seem best to attempt to specify a standard valve, other than to recommend that the construction be such that there will be no chance for the valve stem and the nozzle to be out of alignment.

Cock Grease.

The committee has been in communication with a number of manufacturers of gas ranges and with a number of companies. From them we have learned that there are a good many different kinds of greases, which are quite similar in general character, and any one of which will probably give fairly satisfactory results.

No tests have yet been made to determine the best expression of a specification, but such tests are under consideration in connection with a sub-committee of the National Commercial Gas Association, and it is recommended that this matter be continued in the hands of the committee.

Iron and Steel for Gas Ranges.

A large number of samples of iron and steel have been submitted for examination. These samples have been examined with a view of determining the most satisfactory material for the bodies of ranges where the material could not be coated or treated to withstand corrosion, as mentioned in clause 2 of the Gas Range Specification.

This work is uncompleted and there are a number of samples still undergoing examination. Figs. 4 to 10 inclusive show the condition of some of the linings of the range at the completion of the test.

The committee will be glad to furnish confidentially to any manufacturer or any person interested, the name of any of the metals illustrated.

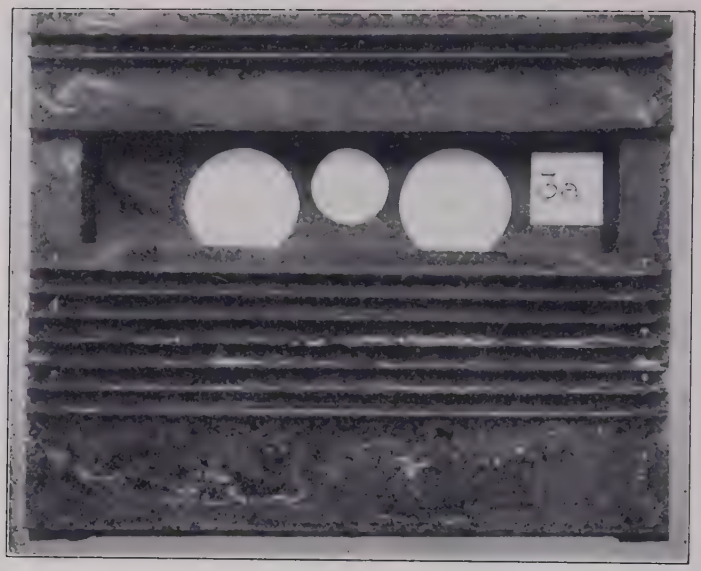


Fig. 4.—Sample No. 3-A, pure iron. Page 1519.

Fig. 5.—Sample No. 3-B, pure iron. Page 1519.

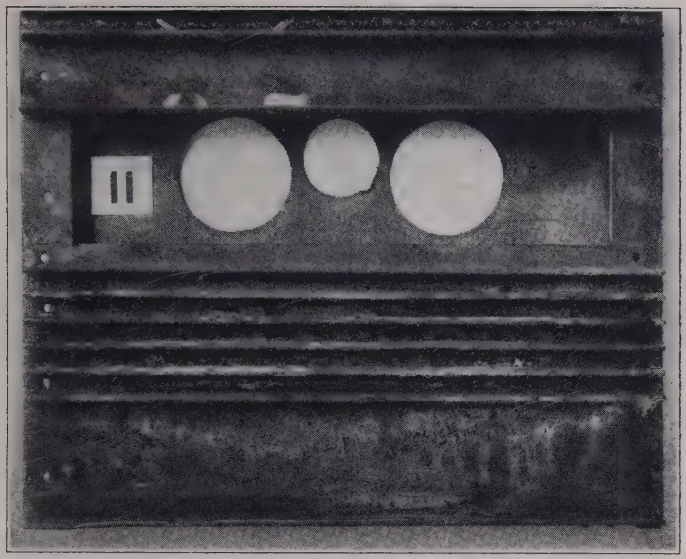


Fig. 6.—Sample No. 11, pure iron. Page 1519.

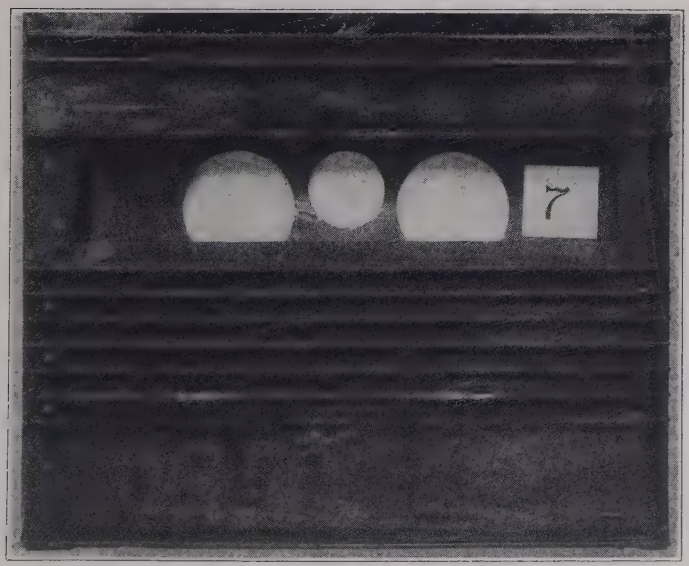


Fig. 7.—Sample No. 7, copper bearing steel. Page 1519.

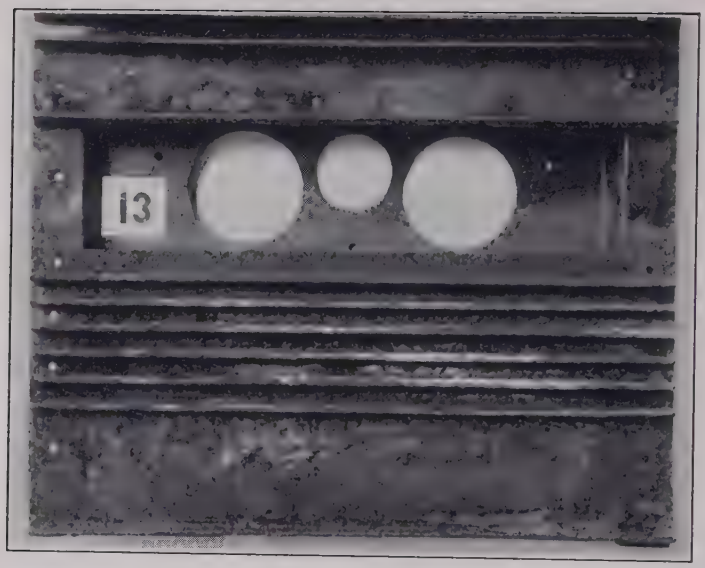


Fig. 8.—Sample No. 13, copper bearing steel. Page 1519.

Fig. 9.—Sample No. 4. open hearth steel. Page 1519.

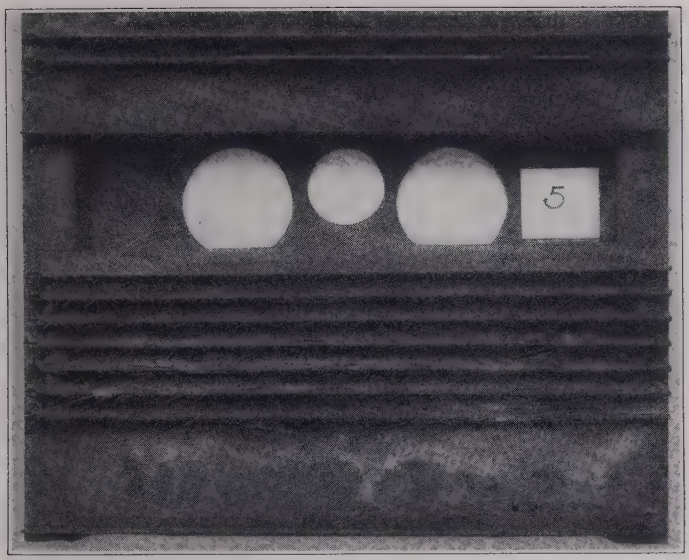


Fig. 10.—Sample No. 5, open hearth steel. Page 1519.

Fireless Cooking Gas Ranges.

A number of so-called fireless cooking gas ranges have been examined, and it seems to us that when these appliances are used as fireless cookers for boiling, stewing or doing similar work, the gas heated fireless cooker is undoubtedly an economical and satisfactory appliance.

For ordinary baking and similar purposes, where the woman who is using the range is also engaged in other household duties, and when she will be willing to study the operation of the range and use it as it is intended to be used, it is a desirable device. On the other hand, when the range is used by those persons who are not directly interested in labor saving, but who are more interested in accomplishing a certain result in the shortest possible time, the range will not give satisfactory results.

At best, the saving is relatively small, and it is very questionable if the saving in gas will be sufficient to off-set the in-

creased first cost of the range necessary because of the more expensive construction.

Section II.—Water Heating.

Very little has been done on this subject.

Section III.—Industrial Appliances.

While the use of gas for industrial purposes has been very greatly extended, and appliances for performing the various kinds of work much improved, there has been no marked change either in the design of the appliances or in their application.

Surface Combustion Appliances.

These appliances have not been placed on the market in such numbers as will warrant us in definitely determining their value. It is recommended that all those companies using surface combustion appliances, communicate with the committee, in order that the information may be collated and published.

Section IV.—Room Heating.

An unfortunate combination of circumstances prevented the erection of the trial room, so that no tests have yet been completed to determine the relative value of the different kinds of heating appliances. It is recommended that this work be actively prosecuted during the coming year.

In accordance with a suggestion to improve fireplace heater design, a joint committee of the American Gas Institute and the National Commercial Gas Association has been formed to supervise a prize competition for room heater design. Information concerning this competition may be obtained in the August and September, 1914 *Gas Institute News*.

Section V.—Gas Tubing and Its Connections.

During the past year, the composition-covered metallic tubing referred to in the report to the 1913 meeting, has been still further improved. From all accounts, it seems to be far in ad-

vance of any tubing which heretofore has been on the market, and it has been adopted by a large number of gas companies.

Because of its construction, the end may be securely attached to the tubing, and this, coupled with the quality which allows it to be used with the gas on it continually, gives to the consumer a flexible connection that is safe, convenient and of good appearance.

At the present time, most flexible tubing is still connected with rubber slip ends. But little improvement has been accom-

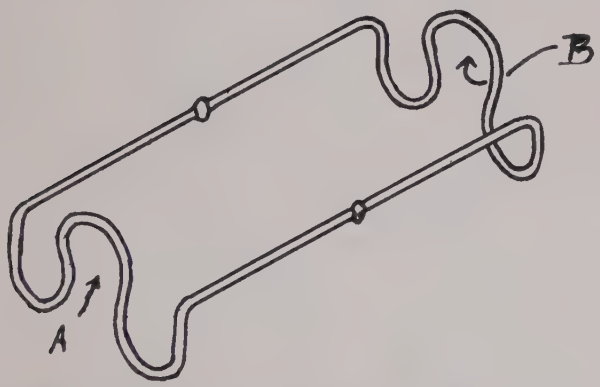


Fig. 11.—This device, which has been on the market for some time, is made of a single piece of wire bent with two loops "A" and "B" at either end. After the tubing has been attached to the slip end, this clamp is installed so that one loop will engage the slip end while the other loop engages the tubing just back of the rubber end, holding the two parts of the joint together. Page 1525.

plished in these ends during the past year. One manufacturer is supplying an end which is corrugated on the inside, and which it is claimed is made of a very much better grade of rubber than was formerly used. Even with this end, however, frequent connections and disconnections so wear the corrugations that after a while they hold no better than the ordinary smooth finished end.

A large number of clamps have been submitted for examination; see Figs. 11 to 23 inclusive. None has proved to be

sufficiently better than the ordinary slip-end to warrant its general adoption. All have considerable merit and further development will be likely to bring forth some device that will lock the rubber end to the gas cock.

A more desirable form of end is the one which is screwed into the tube and by means of a union, is firmly fastened to the wall cock. Samples of this end will be available for inspection at or before the convention, on communication with the chairman of the committee.

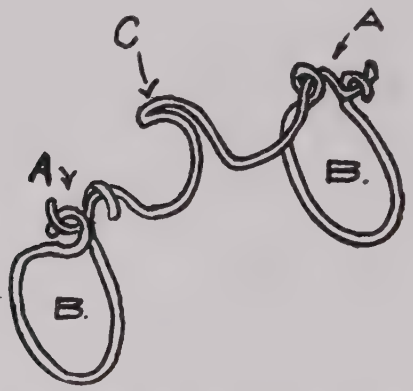


Fig. 12.—Wire clamp so designed that by means of the handle "C" and double cranks "A"-"A", the rings "B"-"B" will be made smaller in diameter and press on the ends of the ordinary rubber end in such a way as to clamp them fast. Page. 1525.

The committee cannot too strongly urge a most thorough investigation by the members of the Institute. The slip-end joint, while now in general use, is not an ideal connection, and sooner or later, the industry should provide itself with a more mechanical and more permanent form of joint.

Section VI.—Lighting Appliances.

Combination Gas and Electric Fixtures.

Early in the year the matter of a specification for combination gas and electric fixtures was taken up with the National

Electric Light Association through its secretary. We were referred to the Committee on Wiring of New Houses, and have just learned through the report of that committee to the annual convention, that it is considered inadvisable to draw up

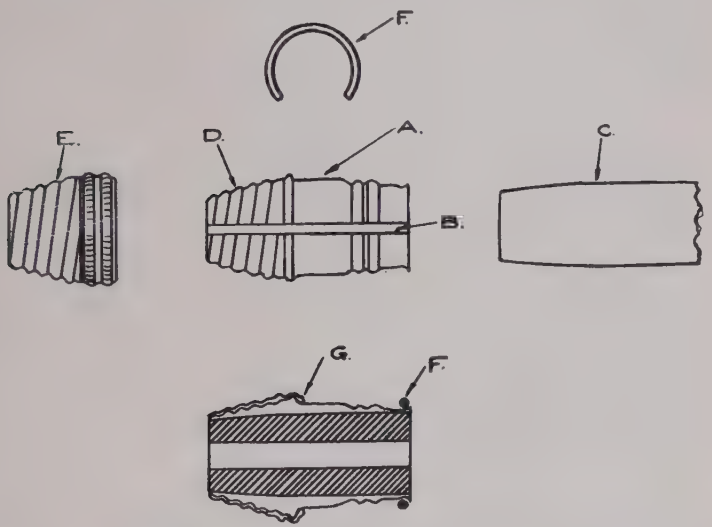


Fig. 13.—A further development of the device illustrated in Fig. 12. A metal sheath "A" slit as at "B" is designed to slide on to the rubber end "C". One end of the sheath "A" is corrugated helically as shown at "D" and a tapered nut "E" with threads to fit the threads "D" on "A" is provided. The sheath "A" with the nut "E" is slipped on to the rubber end "C", and is then held in place by the split ring "F", as shown. The nut "E" cannot come off the end because it is turned in as shown at "G". The sheath on the rubber end is tightened by screwing up on the tapered nut "E" so that the sheath binds the end tightly. Page 1525.

a standard specification for fixtures. The electrical fixtures must, at the present time, conform with the Fire Underwriters' rules for wiring, but outside of that, there is nothing to govern the construction. It is possible that further work along this line will lead to a closer co-operation between the National Electric Light Association and the gas associations, and that

some form of specification may be drawn up for these combination fixtures, which will be satisfactory to both the electric and to the gas interests.

The features involved in this negotiation relate more to the general arrangement of the parts of the combination fixtures than to their detailed construction. Every gas company should insist, in so far as it has power to do so, that the combination fixtures used in its city should conform, in quality of material,

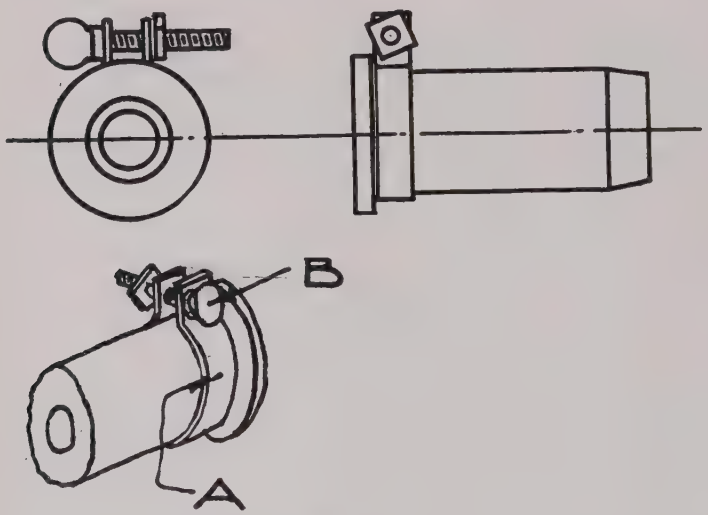


Fig. 14.—A common type of hose clamp. A circular strip "A" being drawn together by means of a bolt and nut "B", compressing the end. Page 1525.

weight and size of tubing, construction of gas cock, etc., with the Standard Gas Fixture Specification of the Institute. There are, however, other considerations that relate to combination fixtures alone. There are on the market such fixtures, in which the gas outlets are so located that nothing but a flat flame gas burner may be used on them; others which preclude the use of inverted gas burners; others which locate the gas outlets so close to the ceiling that gas cannot safely be used

on them. Such fixtures are "combination" only in name. Naturally the electric interests are slow to co-operate in a move

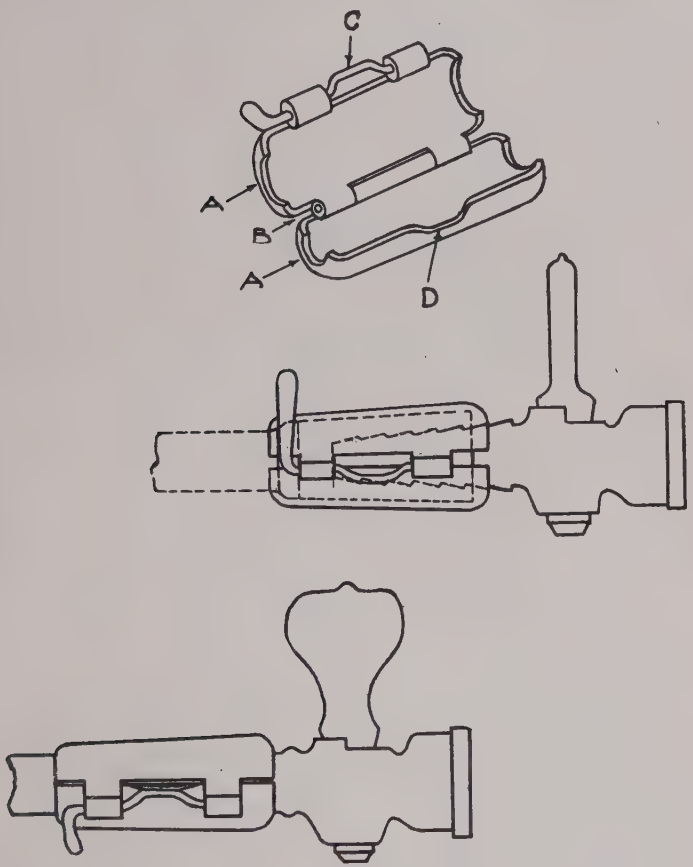


Fig. 15.—Two steel casings "A"-"A" are hinged at "B". These casings are made so that they are somewhat smaller than the rubber end. When they are placed over the rubber end, the cam "C" is turned and engaging the lug "D", tightens the shells around the rubber end. Page 1525.

that will give the use of gas an equal chance. These interests, throughout the country, are competing vigorously for the in-

troduction of electric lighting into medium sized and smaller dwellings. Every gas company should do its best, when dwellings are being constructed, (1) to have them piped, (2) if the builders insist on wiring, to secure the use of combination fixtures, instead of all-electric fixtures, and (3) in such case,

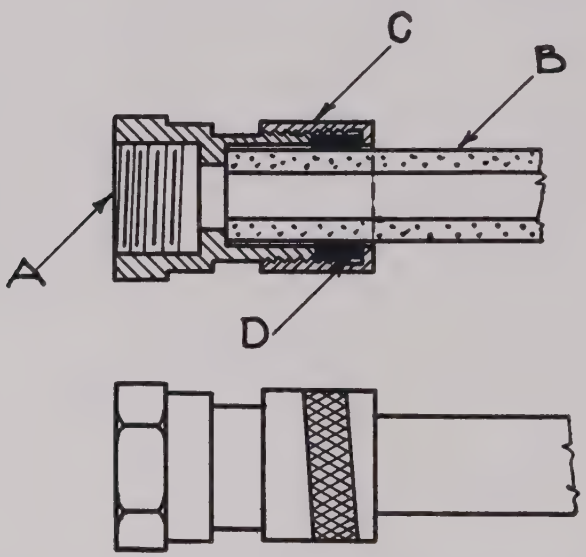


Fig. 16.—A special end "A" is provided, recessed to fit the tubing "B" which is unprovided with an end, but which has in place of it a union nut "C" slidably placed on the tubing and prevented from coming off by means of the annular rubber gasket "D". To attach the parts together, the tubing "B" is inserted in the recessed portion of "A" so that the gasket is in contact with the metal end and the union nut "C" tightened up, causing the gasket "D" to bind on the tubing and hold it tightly. Page 1525.

to make sure that so far as the make-up of the combination fixtures themselves is concerned, gas has an equal chance with the electric light.

Another question which has not been touched on, because it has so recently been brought to our attention, is the possi-

bility of the standardization of the threads for gas fixtures.

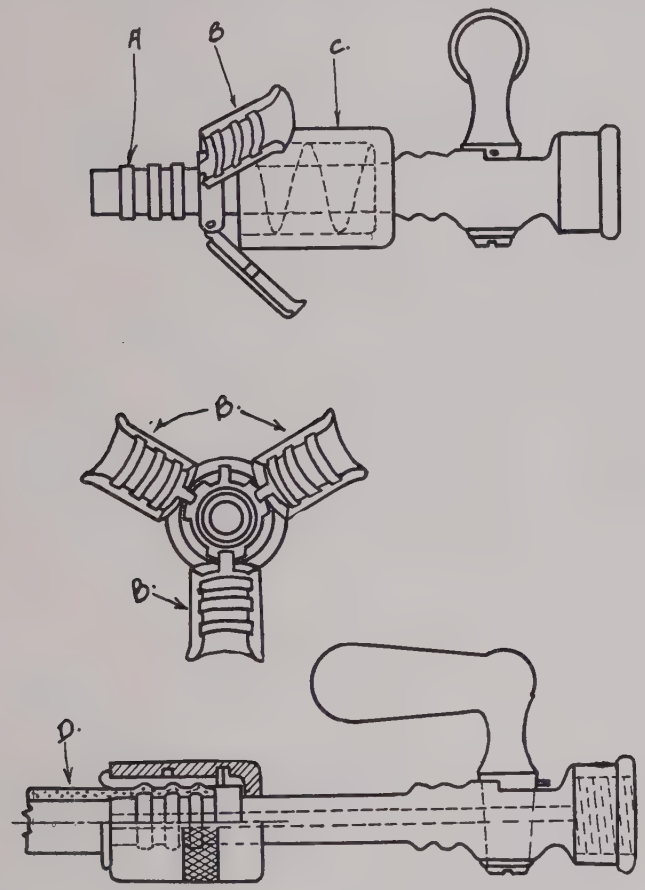


Fig. 17.—The cock or permanent end is provided with an extension "A" which has raised corrugations. Between this end and the cock are hinged three sleeves "B" recessed to correspond with the corrugations on "A". Behind these there is a nut "C" interiorly threaded so that as it is turned, it will move forward and lock the shelves "B" over the rubber tubing "D" which is slid on to "A" in the usual manner. Page 1525.

It is likely that this question of standard threads will be con-

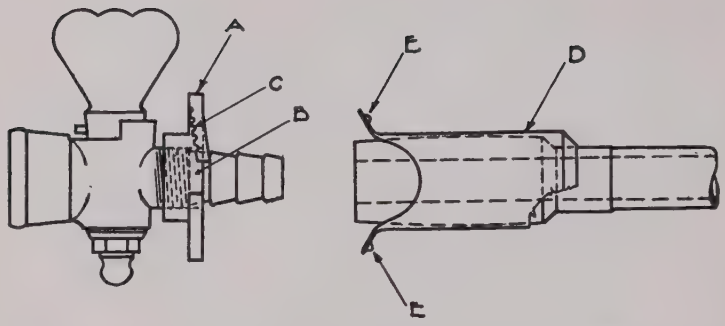


Fig. 18.—The sleeve "A" is fastened on to a slip end by threading or by soldering. The sleeve has two notches diametrically opposite, forming bayonet catches "B", the inner faces of which are notched as at "C". Before the rubber end is applied to the tubing, a shell "D", which is movable on the tubing, is put in place and is then prevented from coming off by firmly attaching the end to the tubing in the usual manner. The shell "D" is provided with two ears "E"-"E" designed to fit into the bayonet slots "B", and by means of a partial turn and the engaging of the prongs thereon with the notches "C", hold the end in place. Page 1525.

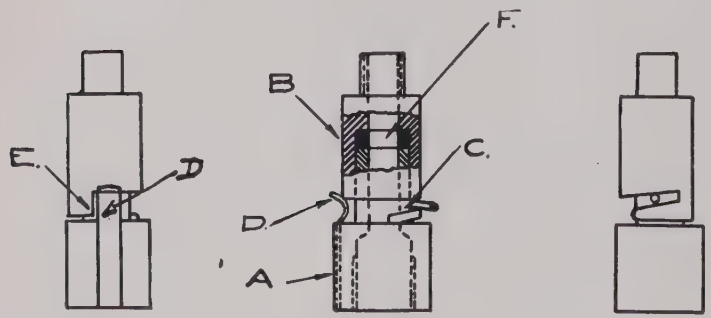


Fig. 19.—The parts "A"-"B" are fastened together by means of the bayonet joint and pin "C" and the spring "D", which, by engaging with the shoulder "E", prevents the bayonet joint from being turned accidentally. A gas tight joint is made by the compression of the rubber gasket or washer "F". Page 1525.

sidered by several industries interested therein under the guidance of the American Society of Mechanical Engineers.

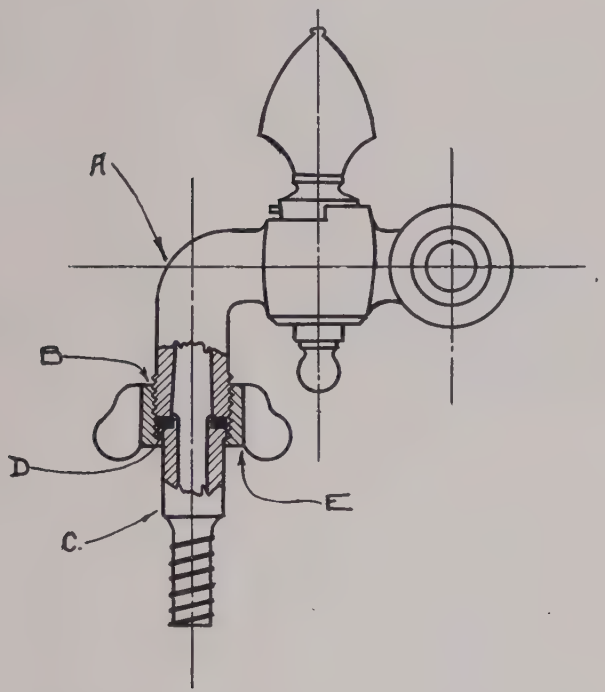


Fig. 20.—An independent or wall cock "A" is provided with a special thread "B". The tail-piece "C" is fastened to the tubing in any desired way; in the case illustrated, it being provided with a thread for internally attaching to a piece of metallic tubing. The tail-piece is also provided with a hard fiber washer "D" held in place by a knurl as shown. A wing nut "E" is slidably attached to the tail-piece "C". To make the joint, the wing nut or union is made up so that the fiber washer will be in compression between the tail-piece and the body of the cock. Page 1525.

In the report of this committee made to the Institute at the meeting in 1912 occurred the following:

"Gas companies should confine their use to better grades of lighting appliances. They should refuse to handle the cheaper forms of incandescent lamps. This policy is of special importance in connection with the use of gas mantles; only the best grade should be handled by gas companies, who should do everything in their power to discourage the purchase by gas

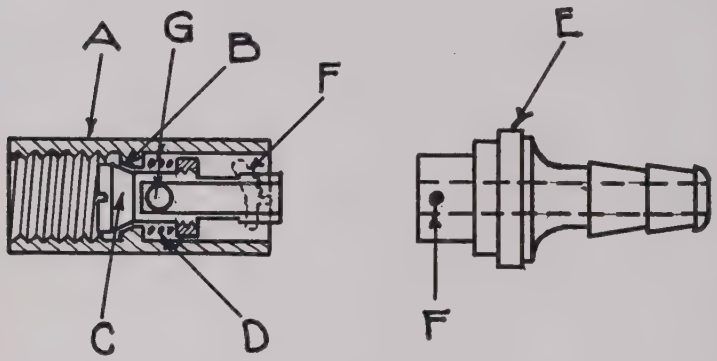


Fig. 21.—The body of the fitting "A" is provided with a valve seat at "B" and an axially moving valve "C" held shut by means of the spring "D". The valve "C" is unseated by the attachment of the other part of the fitting "E" which may be fastened to the tubing in any desired way. When "E" and "A" are held together by means of the bayonet slot and pin "F", the valve "C" is pressed from its seat by the contact of "E" with "C", and gas passes through the hole "G" into the hollow portion of the valve "C", and thus through the other part of the fitting "E" to the tubing. With this device, if the fitting "E" is detached from the fitting "A", the valve "C" will be closed by the spring, preventing an escape of gas. Page 1525.

consumers of the cheap and poor mantles that are on the market. The fact that the manufacture of electric lamps has been so thoroughly standardized, that these lamps are of a uniform quality of excellence, and that the electric lighting companies generally refuse to handle or supply anything but the best lamps, serves to give the electric companies an immense advantage over the gas companies, many of whom will

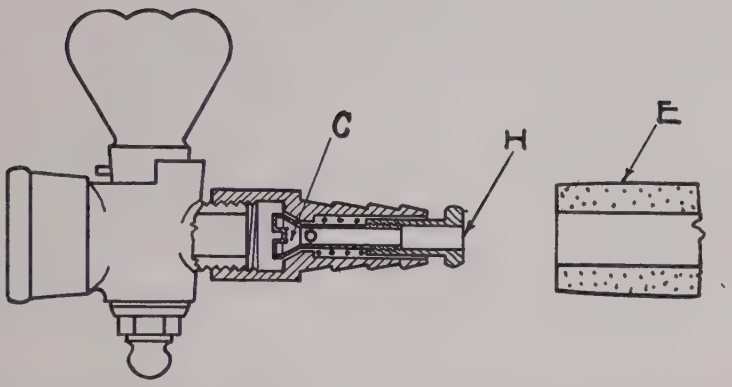


Fig. 22.—Somewhat similar in principle to the device shown in Fig. 21, but in this case, instead of using a separate piece of metal for making the connection between the tubing and the permanent part of the fitting, the valve "C" is operated by the extension piece "H", which is a part of the valve, and which is moved inwards by the application of the rubber end "E". So long as the rubber end is in place, the valve "C" will remain open, but if the rubber end "E" be pulled off the cock, the valve "C" will close and shut off the gas. Page 1525.

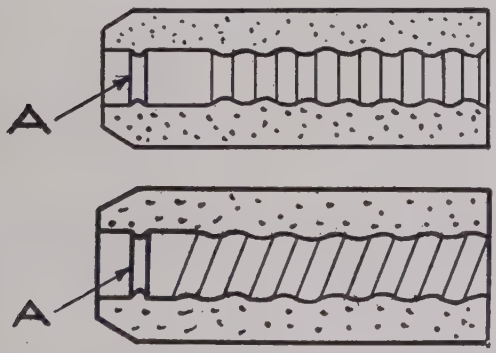


Fig. 23.—Two forms of rubber end, one corrugated with annular corrugations, the other with helical corrugations, intended to increase the friction between the rubber end and the metal slip end. By providing a lug or knurl "A"-"A" and the use of a special nipple, the rubber end may be attached very strongly to the tubing. Page 1525.

carry all grades of mantles and incandescent lamps in stock, and will sell them to their consumers.

"Some attempts to standardize the gas lamps and mantles that come on the market have been made; the subject is surrounded by many difficulties but the committee believes the Institute should take the matter up by the appointment of a special committee to consider it."

It has recently been brought to the attention of the committee that a very large brass manufacturer is making incandescent gas burners of such inferior workmanship that he fears to test them because of the large number which would be rejected. This method of manufacture is made necessary because of the demand by incandescent light manufacturing companies for a cheap burner to meet the competition which has been created by the very general sale of incandescent lighting appliances not only by gas companies, but by merchants in all lines of business. The same manufacturer of these incandescent gas burners makes parts for electric light manufacturers, and has called attention to the difference between our practice and that of the larger electric light manufacturing companies who are constantly improving their standards, and refuse to be drawn into cheap competition, which nevertheless does exist to a small extent in the electric light industry.

The same unfortunate lack of high standard also prevails in the manufacture of mantles; not only of the mantles made in this country, but of those imported.

The committee firmly believes that the interests of gas lighting will be best served by gas companies doing all in their power to discourage the use of inferior grades of burners and mantles.

It is hoped that a special committee will be appointed, to consider the standardization of lamps and mantles, as recommended in the report of the committee for 1912.

The competition with the electric light is becoming more and more keen. We welcome as an encouraging feature, the appointment of the new Committee on Illumination. We

recommend to their serious consideration, certain radical differences in methods and practices, as between the gas and electrical industries, in the endeavor to secure the lighting field. Compare, for example, the central station practice of granting free renewals of their most efficient burner, with the traditional gas practice of granting free renewals only of their most inefficient burner, the flat flame burner. The larger central stations have always realized the importance to them of "controlling the situation"—a phrase that is in common use among electrical managers and engineers—meaning thereby, that only by means of free renewals of the best burners, can they keep out of use the cheaper, more inefficient, "flash" burners that would soon flood the market. If this consideration is of such importance to the electrical industry, can the gas industry safely afford to ignore it?

Section VII.—All-Gas Kitchens.

It was hoped that the committee would be able to give some definite figures illustrating the use of gas ranges in all-gas kitchens for heating during the winter time. A comparative consumption and temperature curve has been obtained, which, while it does not show very definite results, does indicate that the consumption will vary inversely with the temperature, and that if all-gas kitchens are to be a success, some more satisfactory means for the heating of the kitchen must be provided than the use of the gas ovens. Several different plans are under consideration, such as the use of a coal water heater and a radiator, the hot water from the heater to be used not only for heating the radiator, but to be used for the domestic hot water supply; or the use of some form of gas heater which will be more efficient as a heating appliance than the gas oven.

The committee received a request from the National Commercial Gas Association for a simple and satisfactory formula for calculating the amount of hot water radiation required for heating kitchens.

After going into the matter thoroughly and considering the

various formulae proposed by heating engineers, a formula was decided on and submitted to the American Society of Heating and Ventilating Engineers.

This formula was discussed in a paper by Mr. James A. Donnelly, member of that society, at its semi-annual meeting held in Cleveland in July, and the formula as modified by Mr. Donnelly met with approval of the convention.

Suggested Formula for Calculating the Necessary Amount of Radiation for Heating Rooms by Hot Water, Particularly Applicable to the Heating of All-Gas Kitchens by Hot Water From a Furnace Coil or a Water Heater.

To calculate the amount of radiation required for heating a room, we should definitely know all of the conditions which exist.

For instance, we should know whether the room is to be heated by this radiation alone, that is, should the radiation be sufficient properly to heat the room without any assistance from the range or other appliances. Also we should know whether the room is to be used more or less as a sitting room, and therefore to be maintained at a temperature which would be comfortable to persons who are not moving about.

We should know whether the temperature of the room is to be maintained only when the outside temperature is at its low average, or whether the temperature of the room is to be maintained at the probable lowest outside temperature. We should also have information on the construction of the building, particularly with regard to the tightness of the joints around the doors and windows.

The formula submitted assumes an average dwelling in average condition, and different constants are to be employed for different locations and exposures. It also assumes that the temperature of the water in the radiator will be approximately 170° F.

Note: It is to be noted that when the radiation is in

series with the hot water supplies for toilet or other fixtures of the house, that the heater supplying the radiator should have sufficient capacity to take care of both the radiation and the hot water used for the fixtures. It is also to be noted that when the water is supplied at city pressure and not from an expansion tank, that the radiators, as well as the heaters should be so constructed that they will withstand the maximum water pressure.

FORMULA SUGGESTED BY MR. DONNELLY.

A. Add to the square feet of window surface (if storm windows are used multiply by 0.5) the square feet of the exposed door surface.
B. Multiply 0.3 by the square feet of the exposed walls exclusive of windows or exposed doors (where there is a storm door or a door which opens on an enclosed porch the door surface is considered as a part of the wall surface).
C. Multiply 0.1 by the square feet of floor if the room is over an unheated space, the temperature of which is assumed to be 30 deg.
D. Multiply 0.3 by the square feet of the ceiling if the room is under an unheated space, the temperature of which is assumed to be 30 deg.
E. Multiply 0.02 by the contents of the room in cubic feet (this allows for one change of air per hour by leakage).
F. Add together A, B and E.
G. Multiply this sum (F) by the difference between the lowest outside temperature and the desired room temperature in degrees Fahrenheit.
H. Multiply the sums of C and D by the difference between 30 deg. and the desired room temperature in degrees Fahrenheit.
I. Add together G and H.
J. Increase (I) by 10 per cent. if the room is exposed to North or West.
K. This sum (J) divided by 150 will give the amount of radiation required in square feet.

First Example.

Assume a kitchen ell, the room being 12 ft. square and 8 ft.

high with neither cellar below nor room above, on the north side of the house so that there is one wall exposed to the north and one wall exposed each to the east and west. There is one window on each of two sides, each window being 6 ft. high by 3 ft. wide and one door 7 ft. high by 2½ ft. wide. The building is in a part of the country where the lowest temperature is —10° F., and it is desired to keep the room at 65° F. during the time of greatest cold.

A.	Square feet of window and outside door surface = 2 × (3 × 6) + 7 × 2½ =	53.50
B.	Square feet of exposed walls exclusive of windows and outside doors = 3 × (8 × 12) = 288 — (A) 53.5 = 234.5 multiplied by 0.3 = ...	70.35
C.	Square feet of floor surface = 12 × 12 = 144 multiplied by 0.1 = ...	14.40
D.	Square feet of ceiling surface = 12 × 12 = 144 multiplied by 0.3 = ...	43.20
E.	Contents of room in cubic feet = 12 × 12 × 8 = 1,152 multiplied by 0.02 = ...	23.04
F.	A + B + E = 53.5 + 70.35 + 23.04 =....	146.89
G.	F multiplied by 65° — (—10°) = 75° × 146.89 = ...	11,016.75
H.	= (C + D) × 65° — 30° = (14.4 + 43.2) × 35 = 57.6 × 35 = ...	2,016.00
I.	= G + H = 11,016.75 + 2,016.00 =.....	13,032.75
J.	= I + 10% = 13,032.75 × 1,303.27 =.....	14,336.03
K.	= J divided by 150 = 14,336.03 ÷ 150 =...	95.57

Square feet of radiation required is then 96 sq. ft.

Second Example.

Assume a kitchen on the south side of the house with only one wall exposed. The kitchen is 12 ft. square by 8 ft. high, with one window 6 ft. by 3 ft. and one outside door, 7 ft. by 2 ft. 6 in., opening on to an enclosed porch. There is a cellar below and room above the kitchen, both warm. The location is in a town where the low average temperature is 20°, and it is desired to keep the room at a temperature of 70° F., during average cold weather.

A.	Square feet of window surface (no outside door) = 6 × 3 = ...	18.00
B.	Square feet of exposed walls exclusive of windows and outside doors = 8 × 12 = 96 — (A) 18 = 78 multiplied by 0.3 =	23.40
C.	Not to be considered as the spaces above and below are heated.	
D.	Not to be considered as the spaces above and below are heated.	
E.	Contents of room in cubic feet = 12 × 12 × 8 =1,152 multiplied by 0.02 = ...	23.04
F.	A + B + E = 18 + 23.4 + 23.04 = ...	64.44
G.	= F multiplied by 70 — 20 = 50 × 64.44 =	3,222.00
H.	Not to be used as C and D are not used.	
I.	= G + H = 3,222 + 0 = ...	3,222.00
J.	The room is only exposed to the south, nothing added = ...	3,222.00
K.	= J divided by 150 = 3,222 ÷ 150 = ...	21.50

Radiation required is then 22 sq. ft.

W. J. SERRILL, *Chairman.*
G. S. BARROWS,
W. J. CLARK,
J. A. NORCROSS,
W. H. PETTES,
G. D. ROPER,
C. E. REINICKER,

(Mr. Barrows read an abstract of this report.)

(Mr. G. I. Vincent acted as temporary chairman.)

THE ACTING CHAIRMAN: Gentlemen, you have heard an abstract of the report of this committee, and it is now open for discussion.

MR. W. H. ROGERS (Paterson, N. J.): There is one point I would like to raise for consideration, and that is, in the nomenclature of ranges, as to whether they are right or left hand.

MR. J. P. HANLAN (Newark): Under the subject of gas ranges, referred to in this able report, it seems a pity that reputable manufacturers of gas ranges in this country cannot

receive more support from associations such as this. I imagine there would be difficulties which might prevent this association and other associations of national scope, issuing these tags to the manufacturers who build ranges to conform to these specifications. I would like to see what the manufacturers have to say about this subject themselves; but it seems to me, from what I know of some of the chaps who are endeavoring to break in on the gas range business, the same as they have broken in on the gas lighting appliance business, that unless the reputable manufacturers are afforded some protection in the issuing of these tags, the other manufacturers who are members of no association and responsible to no one, will make use even of the tags, if they are given the privilege of making them themselves.

On page 1524, in reference to a prize having been offered by this Institute and the National Commercial Gas Association, I think that is a very good thing, because it is going to stimulate, and is stimulating, the manufacturers of fireplace heaters to give us a heater that measures up to the surroundings where it is to be placed. We have heaters now that are efficient, but some of them are lacking in design. Mr. Barrows says that this afternoon we will take up the section on illuminating appliances, but I would like to mention it here, in case I forget about it this afternoon, that this association should make some arrangement with the National Commercial Gas Association whereby a prize could be offered for combination gas fixtures that would be combination in use as well as in name.

In regard to gas tubing, I think I know the tubing that is referred to in this paper, and I know of a gas man who has used a piece of this tubing for over one year, connected to a portable reading lamp, equipped with a pilot, and he tells me that so far as he can see, there has been no appreciable deterioration in this tubing. I have also heard other gas men say, "Yes, it is good tubing, but it costs about twice as much to use." What is the difference if it will cost three times as much as other tubing, if it will last five times as long and the public

is willing to buy? I have always been in favor of giving the customer the last say as to whether he should buy the appliance, and not the gas man. I would like to second the suggestion made by this committee, to have a committee from this association and other associations consider the ways and means of bringing about the standardizing of lamps and mantles. Poor mantles and burners have done more to injure the lighting end of our business than anything I know.

(Mr. Reinicker again acted as chairman.)

THE CHAIRMAN: I feel we ought to hear from the manufacturers, and for that reason I would like to ask to hear from Mr. Roper.

MR. G. D. ROPER (Rockford, Ill.): The National Commercial Gas Association and the American Gas Institute have both spent the last two years, and the committees have worked hard in both institutions to specify what the best thought of the manufacturers and the gas people was as to the best type of gas range that could be manufactured. With that idea in view, they have formulated the specifications on which both associations agree. The question now comes up, "Is silk, silk; is cotton, cotton; and is wool, wool?" And I myself am very emphatic on the point that every single solitary gas range manufactured should bear a tag, "Made according to the specifications of the American Gas Institute and the National Commercial Gas Association." If the manufacturer wants to make a range that is not according to specifications, it cannot bear the tag. If it bears the tag, and that tag says that that is in accordance with the specifications of the two leading associations in this country, you therefore have not only the word of the manufacturer that this is the best range that can be made.

Now, gentlemen, as a manufacturer, I believe emphatically that no gas company—I do not care whether big or little—but what should put a range on their floor and say, "There is a range according to the specifications of the two best associations, the two large associations of this country, and it bears the tag. This range is guaranteed by the manufacturer to be

constructed in accordance with the gas range specifications adopted by the National Commercial Gas Association and the American Gas Institute." For this range, charge $2.00 or $3.00 extra. Alongside of this gas range, have another one made by the same factory, without the tag, and not made according to specifications, and you will sell more of the ranges with the tag, and it will not take long to demonstrate that the people are anxious to have the better grade of gas stoves.

Mr. F. W. Schmidt (Jersey City): In the report of this Committee's meeting on page 224 of the July, 1914, number of the *Gas Institute News,* the important subject of complaints from sediment in water supplied from circulating tank heaters, was mentioned. It is recommended that customers be advised to draw water from the drain-off cock frequently. The permanent drain-off cock connected to the average boiler installation, is usually in such an inaccessible position that the customer seldom if ever can use it. On all advertising issued by manufacturers and gas companies, showing cuts of circulating heaters connected to boilers, there is always a draw-off cock shown at a convenient point to serve the purpose intended. I am constrained to believe that there is no real effort made on the part of the salesman or fitter to have the customer add this waste cock at the time of installation of the heater.

Where an order for waste cock has not been obtained, I think if a short description of its advantages was printed on a red card and attached to the bottom of the heater at the time of installation, it would serve as a constant reminder to the customer that there is a remedy for sediment trouble, and sooner or later he will be induced to make the addition of the waste cock to his water heater installation.

The advantage of the draw-off cock at this point, over the waste cock connected to the house plumbing, is that it is accessible and the customer can see at all times the exact condition of the water in the bottom of the boiler as to cleanliness.

I believe that it is of equal importance that no furnace heater

be connected without a draw-off cock being inserted in the piping at the lower point in the system.

Mr. Stanley Grady (Philadelphia): I would like to ask the Committee what would be the objection to using hexagon nuts, rather than round lock nuts, with the gas range cock?

Mr. H. W. Terry, Jr. (Ossining, N. Y.): The Committee has taken up the subject in much detail and the question of electric competition has been touched on. In that connection, I would say that the electric people are pushing, to a large extent, the use of small electric heated devises such as chafing dishes, disk stoves, toasters and percolators, with the result that people are being educated to the use of electricity for cooking, and when reductions in rate for current can be made, it will be an easy step to the use of electric ranges. The gas men have done very little so far in developing the field of the small gas heated domestic units similar to the electric ones mentioned, and I believe that considerable business could be obtained in this line.

Mr. H. D. Schall (Detroit): I believe that the majority of manufacturers of gas ranges are desirous of bringing before the public the very best appliances possible, but there is a question in my mind as to whether the tag referred to on appliances would convey to the public or the gas company any significance or guarantee. My personal idea would be that if such a guarantee is necessary, the manufacturer be requested to address a letter to both the Institute and the National Commercial Gas Association, signed by an authorized officer of the company, stating that all appliances manufactured by them would be made under the standard specifications, and if there were any exceptions, that they be mentioned in the letter.

Mr. W. M. Crane (New York): I think the Committee ought to be complimented on the record it has made in the manufacturing quality of different ranges. I have no objection to the tagging excepting this, that "many men are of many minds." When it comes to the tagging of the range, it must be exactly according to specification. Some of you gen-

tlemen coming to buy ranges, might claim that some part, whatever part it might be, of the range if changed to meet their ideas, would be just as good or better, yet a trifle cheaper or dearer, as the case might be. This would differ from the standard range. Now, our range as made would be standard in all the essential features excepting these one or two minor parts that may have been changed, and yet under the circumstances, we could not tag it.

Mr. R. E. Sard (Albany, N. Y.): Mr. Chairman, I think it would be of interest to the members here to realize that this proposition of standardization of specifications came from the manufacturers. I think we are all agreed that a great deal of the credit for the progress in the electric industry has been due to the co-operation between the manufacturer and the central stations.

Several years ago, there were several sets of gas range specifications. At the Denver meeting of the National Commercial Gas Association, while I was Chairman of the Manufacturers' Committee, I suggested that it would be well to get together and adopt some one specification as a standard. Committees of both associations were appointed, the membership being made up not only of representatives of gas companies, but representatives of manufacturers. The result is that a standard specification has been adopted, which is a limiting specification, drawn up to be as broad as possible. This specification outlines the proper method of construction of the principal parts of the range, and sets a limit below which it is not desirable to go in building the ovens of standard ranges. It also specifies certain qualities of materials for construction. The specification is so drawn as to permit the broadest interpretation and allow improvements in construction.

It is largely a question of education, and I believe that the way to educate the buyers and the public is to put tags on these ranges. It will entail some expense to the manufacturers, but I believe after the buyers have been educated that they will be willing to pay more for the standard ranges. We can accom-

plish work along the same lines by writing letters and saying that our stoves are going to be made according to specification, but these letters will not accomplish the same educational result. I think that we should consider the wishes of the manufacturers, and we must realize that anyone detail, which is not conformed to in the specification, will necessitate the leaving off of that tag.

I want to call one point to your mind. Probably 80 to 90 per cent. of all ranges are made with the so-called adjustable cock. The specification calls for the fixed orifice cock. None of those ranges with the adjustable cock can have this tag on. I believe this is one point that ought to be taken up by the Committee and settled.

Mr. J. L. Mayfarth (Denver): It seems to me that the Committee is handling the work in a way to bring the most benefit to the gas companies, without working hardship to the manufacturers. By insisting on important features of construction, a high grade product is insured, while the details are left to the discretion of the manufacturers, giving latitude for improvement and individuality of product.

I would like very much to hear some reports from companies who have had experience with surface combustion appliances. We have heard a great deal of this innovation for the past two or three years, but we do not seem to be receiving many reports of a practical nature.

The paper mentions fireless cooking gas ranges, and while I agree with them in what is said in regard to the adaptability of this range for household use and other places where the gas consumption is small in any type range, I would like to hear an opinion as to the possibility of constructing a range or large bake oven on this principle, that could be used for industrial work where gas consumption is an important point.

Mr. J. C. D. Clark (Salt Lake City): The report of this Committee opens a large field and one which may be extended indefinitely. I am glad to offer such comments as come to me from observation and experience.

Cocks and Valves.—The search for the ideal lubricant for range cocks is conducted on the theory that the trouble with the cocks is the fault of the grease. To me it seems like a hunt for the right kind of spectacles for a blind man. Impurities from the gas and conducted heat do the mischief, and I cannot conceive of a grease that will resist these agencies. Whatever kind of grease is used, it will have to be renewed at intervals. That means "send a man." The conducted heat acts on the grease, the cock flies around at the slightest touch and the user of the range sends word that it is too loose. You have to "send a man."

A strong man with a screw driver will tighten the cock in a hurry. The user pronounces it all right. But when the stove gets cold, the cock must be hit with a flat iron to move it. Again it is a case of "send a man." "Sending a man" costs money. Sending him on something that might be avoided is a waste of money. The continuing expense is one objection to the cock. Another objection is the accident hazard. Because the cocks can be used in comparative safety by one who is accustomed to gas, it does not follow that they are safe where children live or for beginners.

Any attachment that causes needless expense and fatal accident can be justified only by some great advantage. The stop-cock has no such advantage. It is the crudest device in the mechanics of the gas business. Wherever it is in contact with gas, whether on ranges, heaters, meters or gas manufacturing apparatus, it speedily becomes unserviceable.

I venture to say that if you sent a committee out to look at the first fifty meters in the neighborhood where you happen to be, the committee would have trouble in turning the cocks on 49 of them.

In my opinion your report would be shortened and strengthened by saying in place of the grease discussion: "Cocks are obsolete in the gas business; they are wasteful and dangerous, and should be abolished."

Almost any sort of valve is superior to the stop-cock for our

purposes, but there are differences in valves. When the cocks are eliminated from consideration, the best form of valve may be taken up. Inventors should be able to design a valve without the stuffing box. I am sure I have seen at least one model in which the gas rested on the packing only when the valve was open.

Tubing.—I note the many ingenious devices for maintaining the connection between tubing and fittings, and I wonder why the gas men should go out of their way to facilitate the use of tubing.

Detachable connections brand the appliances on which they are used as emergency equipment. A house in which the spaceheater is put away in the cellar or garret and whisked here and there, will not begin to use the gas for heating that would be used if each room had a heater permanently installed and always ready for lighting. Rubber or composition tubes are inherently objectionable on the ground of sanitation and safety. While users persist in trusting a worn out tube rather than pay for fresh tubing, the element of danger must be taken into consideration. The tight connection of tubes and fittings will not prevent leakage from the tubes themselves.

A permanent connection is safest. Risk increases with flexibility. It should be our policy to limit the flexibility and the accompanying risk to the actual necessities of the user. There are some purposes, as for lamps and space heaters, for which iron pipe is too rigid and rubber tubing excessively flexible. These appliances do not need to be carried about the room, nor from one room to another. If they can be moved their own length to permit of cleaning underneath, their range is sufficient.

Why should we not have a semi-flexible tube of very thin brass or copper, connected with a thumb-screw union to the fitting?

For instruments such as the gas iron, where extreme flexibility is indispensable, the rubber and composition tubing does

very well, because it is under constant supervision while the gas is turned on.

By discouraging, rather than facilitating, the use of tubing, and by designing heaters to be kept in place the year round, we can, I think, raise gas heating from its present position as a temporary expedient, to that of a common practice, and increase our sale at the same time.

Kitchen Heating.—The formula for calculating the amount of hot water radiation required for heating kitchens is ingenious; but why attempt to heat kitchens from a hot water supply generated by coal? That is not the business of the gas man. If it cannot be avoided, the gas man will save himself a lot of trouble by letting a plumber do it. Better use the mathematics in proving to the customer he does not get his hot water for nothing by heating it in a furnace. Remove the impression that it takes no more fuel to heat a house and water than the house alone, and the householder will be in the proper mood to consider the gas way.

Kitchen heating, water heating, cooking and refuse burning should be attended to by our three specialists. Kitchen heating and refuse burning are the specialties of the gas-kindled kitchen heater, cooking and baking are the specialties of the gas range, and water heating is the specialty of the gas water heater.

Specialization means economy and efficiency. If the kitchen heater be connected with the water storage tank, so that all surplus heat shall be used to temper the water and relieve the demands upon the gas water heater, the customer has a system in which every heat unit is absolutely accounted for, perfect regulation of temperature is made possible and no unfamiliar duties are thrust upon the gas man.

Why butt in the plumbers' domain when we have a better system in our own?

Products of Combustion.—Relegate the obsolete and alien equipment to the scrap heap, and you will have time to take up a more serious and timely problem, namely, the removal from inclosures of the deleterious products of combustion.

Prof. Milton J. Rosenau, Professor of Preventive Medicine and Hygiene, Harvard, formerly Director of the Hygienic Laboratory, U. S. Public Health Service, states the problem when he says in his new book on preventive medicine (this book is published by D. Appleton & Company and is circulated among the boards of health of every state in the union):

> "Open gas heaters without flues to carry off the products of combustion are bad from a sanitary standpoint. These heaters consist of a series of metal tubes containing air or water, which are heated with naked flames. The heat is thus imparted to the room by convection and also by radiation. Such devices may contaminate the air with carbon monoxide from leakage or from unconsumed gas, or from the formation of soot which becomes incandescent. Such heaters also contaminate the room with carbonic acid and other products of combustion. The 'rubber' tube feeding these gas heaters often leaks, and there is frequently a perceptible odor of gas in rooms where these devices are used."

My views on the tube question have already been expressed. Space heaters using the radiation principle alone do not come within the indictment of Prof. Rosenau.

Just enough has been done by the range manufacturers toward the removal from the kitchen of the products of combustion to whet our appetities for farther development along this line.

The hood represents a slight advance. It catches some of the fumes and cooking odors. No one will say it catches them all. I am satisfied the designers can work out something that will give better results at lower cost.

The problem is to provide a suction draft from the entire field of the top burners, via the flue connection, which will be strong enough to carry off the combustion products without being so strong as to cool the burners unduly.

There are obstacles to be overcome, but they do not seem insurmountable, and the object is worthy of the effort.

Mr. M. S. Sherwood (Summit, N. J.): There is one appliance, not mentioned in the report, used in connection with gas ranges, that is rapidly growing in favor among users of gas ranges. I refer to the heat distributor, which takes the place of the top grates, making a solid top of the range. There are, I believe, two or three types on the market.

I believe it offers many advantages, some of which are: Economy of operation,—one burner will nearly do the work of two. More sanitary,—the space underneath the burners will not become foul as do stoves with the open grates. During the time of preparing a meal, the top, being of cast iron, stores up enough heat to keep food warm for a considerable time, should some member of the family be late.

The open grate top presents an uneven surface, over which cooking dishes, especially small ones, cannot be moved without danger of tipping. The grates are frequently broken, and are almost always unsightly, because, being exposed to the direct flame, they are burned red. A grate is much harder to polish then a smooth surface, and few cooks will take the time to do it.

Should the Committee consider the use of the distributor advantageous, I wonder whether it would be worth while to take up the matter with the manufacturers to see if they would adopt the idea, by making the distributor a more permanent part of the range. This could be done either by casting the top solid, or by making it in removable sections, as the grates are now made. I think the latter would be preferable.

The Chairman: I am very sorry we will have to close this discussion. I am going to ask Mr. Barrows to close it.

Mr. Barrows: Mr. Rogers asks for the definition of right and left-hand ranges.

In the "Specification for Gas Ranges," published in the *Proceedings* of the Institute for 1912, exhibit "B" illustrates the definition of the nomenclature of various types of gas ranges.

We believe that the slip end should be eliminated as rapidly as possible.

Not only is the safety union end (a sample of which is shown in the exhibit on the first floor) a better connection, but it is also much simpler for use by the consumer. It may be readily connected or disconnected without the use of tools. After the two parts have been attached for a period of many months, they may be readily separated, whereas with the ordinary slip end there may be a kind of vulcanization take place in the rubber, which will cause it to stick to the brass slip end. In the latter case, the fixture is often strained, and similar straining of the fixture may occur when making the attachment.

Referring to the marking of ranges, your Committee after talking with a number of manufacturers, has now modified that part of the report referring to this subject, so that there is no definite recommendation that the ranges be so marked.

Mr. Grady suggests the advisability of using hexagon nuts on the new gas range cock. This matter has been very carefully considered and numerous samples have been tested. We find that they are not as readily manipulated by the fitters, because at times the points of the hexagon on one nut will come opposite the flats of the hexagon on the other nut, so that great care in the use of the pliers is necessary.

Referring to the adjustable orifice for gas range cocks, the drawing of the cock has been modified so that the adjustable orifice is permitted.

Mr. Mayfarth inquires about the use of surface combustion and fireless cooking appliances. Surface combustion appliances have not come into very general use, but the committee has had reports from a number of users of hotel appliances, and, so far as we can learn, they are proving satisfactory. Such installation should, however, be made very slowly, as it is necessary to give the appliances a thorough trying out before their general adoption can be recommended.

Regarding the fireless cooking, or heat storage principle, as applied to large appliances, I see no reason why this should not be done. There are now on the market large bake ovens

which take advantage of the high specific heat of water for heating the oven. These ovens are made with coils of pipe around the cooking space, special piping being used to withstand high pressure. These coils are filled with water and then sealed, so that no evaporation can take place. The ovens are heated in the usual way, the pressure of the steam in the pipe reaching many hundreds of pounds. The heat thus stored is made use of for the baking.

Some electrically heated water heaters are made, in which the heating unit is a large mass of cast iron with relatively small water passages. These heaters are heated by current at a constant rate, and it is claimed that there is sufficient heat stored in the iron to properly heat the water when it is drawn through the passages. Many other schemes may be made use of for similar purposes.

Regarding Mr. Clark's remarks on the subject of cocks and valves, the question as to which is the most desirable device to use, may, of course, be considered an open one. Undoubtedly, a good many of the cocks formerly used were unsatisfactory, but with improved design and methods of manufacture, the cocks which are now on the market apparently give as little or less trouble than valves. There is much to be said on either side of this question, both from the standpoints of mechanical construction and safety.

Regarding the use of flexible connections for room heaters, it seems very desirable that some form of flexible connection be continued in use, for portable appliances are very desirable where the space which would be occupied by a permanent appliance, is a consideration. Improved methods of construction of the tubing and devices for attaching the tubing have almost, if not entirely, eliminated the causes of complaint which formerly occurred with the ordinary rubber slip end tubing.

Regarding the use of flueless appliances, it seems to me that while it is generally admitted that appliances having flues are rather more desirable than those without flues, the objection to a flueless appliance has been somewhat exaggerated, and

the very exhaustive tests which have been made, particularly in England, seem to show that there should be no objection to the use of flueless small appliances, particularly if illuminating flames are used.

THE CHAIRMAN: Before we close, I want to thank the Committee for its able work in this matter, and I want also to thank you gentlemen for your interest displayed in this Section. I certainly appreciate the aid which you have given me, and hope that we will meet together in the near future.

MR. O. H. FOGG (New York): Is it not in order to dispose of the report of the Committee on Utilization of Gas Appliances? I think there are some points that ought to be considered further. The Committee recommends in its report that power in one or two details should be left in their hands, and I think that is most desirable, because I know how fair a hearing both sides of this case will get. If a motion is in order that this report go to the Directors, with the recommendation that it be left to the discretion of the Committee to adjust these differences, I would like to make that.

THE CHAIRMAN: The Chair recognizes such a motion.

(The motion was duly seconded and unanimously carried.)

Adjourned, 1 P. M.

ACCOUNTING SECTION.

Morning Session, Thursday, October 22.

Mr. R. C. Dawes (Chicago), *Chairman,* Presiding.

Mr. T. M. Leahy (New York), *Section Secretary.*

The Chairman called the meeting to order at 10.00 A. M.

APPOINTMENT OF SECTIONAL NOMINATING COMMITTEE.

The Chairman: Under the revised Constitution, there is to be a vice-president from each section. This vice-president is to be selected by the Nominating Committee, from three names designated by each section. Following the program adopted by the other sections, it is suggested that this section authorize the Chairman to appoint a committee of three to select the above three names, and to report back at this afternoon's meeting. I shall be glad to hear a motion to that effect, that a committee of three be appointed to select names to submit to the Nominating Committee.

(Motion made and carried.)

The Chairman: Now, I will appoint upon that committee Mr. C. N. Jelliffe, Mr. Paul Doty and Mr. H. L. Rice.

Mr. Rice: Mr. Chairman, will you excuse me from that committee? Unfortunately, I have to be away after 12 o'clock to-day, for the rest of the day.

The Chairman: Very well, Mr. Rice. I will announce another name later. We will proceed now with our program. The first paper is "In Rate-Fixing by Commission, Should 'Depreciation' be Deducted from Plant Valuation?" by Dr. A. C. Humphreys, of New York. I am sure that every member of the Institute appreciates very highly the continued interest of Dr. Humphreys. His long connection with the Institute, his very valuable services to the Institute, his abilities, make him always a very welcome guest, and I have very great

pleasure and I wish to express, in introducing Dr. Humphreys, the very great honor that we feel he has conferred upon us. (Applause.)

IN RATE-FIXING BY COMMISSION, SHOULD "DEPRECIATION" BE DEDUCTED FROM PLANT VALUATION?

The following paper has been prepared in response to a definite request and to meet a definite question. I have written so much on the questions involved in the term "depreciation" that I should have declined this request had it not been apparent that public service corporations are suffering from a wide variety of misunderstanding on the important questions involved. These misunderstandings, resulting in failure to agree on fundamentals, have been evidenced, particularly during the last year or so, in the papers written under this title of "Depreciation," or in connection with papers on valuation of railroad and other public service properties. In this paper, in trying to eliminate some of the misunderstandings, I shall not hesitate to repeat myself whenever I think there is advantage in so doing.

In this connection, it is pertinent to make special mention of the paper, "The Depreciation of Public Utility Properties as Affecting Their Valuation and Fair Return," by John W. Alvord, presented to the American Society of Civil Engineers, December 17th, 1913, and the report of a special committee of that Society "To Formulate Principles and Methods for the Valuation of Railroad Property and Other Public Utilities," presented at the Annual Meeting, January 21st, 1914. Both of these papers have been discussed at length. The former p per and its discussion has been published in the Society's *Transactions,* Vol. LXXVII (1914); the latter and a portion of the discussion only have been published in the PROCEEDINGS for 1914, Vol. XL, Nos. 2, 4, and 5. More of the discussion is to appear shortly.

A paper on the "Physical Valuation of Railroads," presented to the same Society by Wm. J. Wilgus, formerly Vice-President of the New York Central Railroad Company, is encouraging as an offset to the other two papers. This paper and the full discussion appear in the Society's "Transactions" for 1914, Vol. LXXVII.

In discussing this question, the first difficulty which confronts us is that of a meeting of the minds on the definition of the term "depreciation." The term tends to the misleading of the uninitiated, and particularly because it is used to cover two meanings widely apart from each other. In several of my writings, and particularly in the paper entitled "Depreciation: Actual and Estimated," presented last June to the Institution of Gas Engineers (Great Britain) and reprinted by this Institute, I have attempted to minimize this difficulty by differentiating between actual depreciation, as found by expert examination of an existing plant, and estimated or theoretical depreciation, as indicating the opinion of some person or persons, more or less competent, as to the amount of money which should be retained each year from income to provide for the periodic or deferred renewals of the several parts of plant.

To determine the present actual depreciation of plant requires the best judgment of the engineer, completely competent as *constructor* and *operator*. Having so determined its present condition, it may be necessary to determine the cost of renewal of the several parts, taking into account the elements of physical decay, obsolescence, and inadequacy. If a change in ownership is contemplated, the purchaser will be called upon to assume the liability of these renewals, and so it becomes necessary to make this estimate with the greatest possible accuracy. If the property is not to change hands, this estimate is required only to check up the estimated depreciation as employed in connection with the annual charge to "Depreciation Reserve."

Estimated or theoretical depreciation, as employed in con-

nection with the annual charge to "Depreciation Reserve," is primarily a question in accountancy, though for anything like accuracy the co-operation of the engineer and, possibly, the banker, is required—the latter particularly if the Reserve is to be calculated on the Sinking Fund basis. In preparing an estimate which can be in any measure relied upon, the expected life of each of the several parts of plant must be assumed, bearing in mind that the life of each part depends upon the original design, the quality of material and workmanship employed in its construction, the methods pursued in the operation of the plant as to maintenance and duty required, the accountancy methods to be followed, the present state of the art and its future possibilities, and the present and possible demands for product or service. These stipulations at once indicate the chances for error, particularly as the future cannot be controlled as to operating and accountancy methods to be employed.

Providing this estimate is only to be used for the purpose stated, namely, to determine how much shall be retained each year from income and charged to the year's "Loss and Gain Account" (and it should be employed for this purpose only, and not as an acknowledgment of real depreciation), there is no irreparable harm done if the estimate is not entirely accurate, provided a *sufficient* amount has so been charged up from income. If the estimate on accruing cost of deferred or periodic renewals ("depreciation") is found to be in excess of the requirements, a correction can be introduced. Here we have a case similar to an over-reading of a consumer's meter; is the consumer is charged too much through this error of the meter reader, the error is, or should be, corrected automatically at the next meter reading. Carelessness or lack of full sense of responsibility in this respect are not to be lightly regarded, but, if errors do so occur, the way is open to correct therefor.

If this estimated or theoretical "depreciation" is to be the basis for deducting "depreciation" from the valuation of a

public service property, *as it should not be,* it can at once be seen that accuracy is of the utmost importance. Certainly, in such a case, such an estimate should not be based upon the life-tables of text-books and the like, the expected lives quoted being simply the compilation of averages covering the widest possible variations as to design, construction, methods of operation, accountancy, state of the art, and possible demand for product or service.

But, quite apart from the method pursued as to the making of the estimate and the accuracy of the estimate, however prepared, "depreciation," meaning the *accrued liability for the deferred or periodic renewals of plant,* should not be deducted from the valuation of the plant.

As long as the property does not change hands, the owners are obligated to make all necessary renewals, whether necessitated by physical causes, by obsolescence, by inadequacy or insufficient capacity. If the property does change hands, then it is most important that this accrued liability should be determined by detailed examination on the part of experts so that the purchaser may be informed as to the *measure of the liability he is assuming for the plant renewals.* If the plant has been adequately maintained by current repairs and renewals, and if the public service corporation is liable for the periodic or deferred renewals, the plant has not depreciated as to quality of service; and the rate for service allowed should be dependent upon quality of service and, in some measure, upon the investment maintained.

Naturally, perhaps, commissions, courts, and "Experts" testifying against the public service corporations and their many security holders take advantage of the misuse of the term "depreciation" to make deductions therefor from plant valuations based upon cost to reproduce new. Even a partial study of the cases and of the testimony of "Experts" must show to the competent and honest student that there is a regrettable lack of agreement as to the content of the term

"depreciation" so loosely employed. Here we find some justification for the claim of Mr. Charles F. Mathewson, of the New York Bar, where he says, in referring to the leading case of Knoxville vs. The Knoxville Water Company, "The subject of depreciation as affecting values has never been presented adequately to any rate-making tribunal."

Let it now be understood definitely that in opposing deduction from plant valuation for "depreciation," it is assumed that the plant is maintained through current expenditures for repairs and renewals in a condition to render to the rate-payer effective and economical service; that the cost of deferred or periodic renewals is included in the cost of service and that, therefore, the public service corporation can be held liable for such renewals when necessary; and that "depreciation" so defined is not the reduction in worth or value as viewed by a possible purchaser, but is the accrued liability of the owner to renew all parts of plant as these parts become uneconomical or inefficient for operation due to physical decay, obsolescence, or inadequacy.

Mr. R. J. McCarty, Vice-President of the Kansas City Southern Railway Company, member of the A. S. C. E. and A. S. M. E., in an admirable paper entitled "Depreciation of Railroad Property" gives us the term "Latent Depreciation" to cover this accrued liability for renewal of plant This is an expressive term because the loss in value is latent only and does not become potential for any part of plant until the day for the renewal of that part arrives, and when that day comes the part is renewed and the liability therefor is cancelled. By definition, until the day for renewal arrives, each part of the plant is capable of rendering effective service for the rate-payer and the owner alike. This gives the rate-payer full protection and deprives him of the right to demand a reduced valuation because of the "Depreciation Reserve." It is the function of the public service commission to protect the rate-payer in this connection, and it should be the function of the commission to afford an equal protection in the premises to

the public utility corporation. This is what regulation *should* mean.

If we who are trying to protect honest investments in public utility properties—properties which have been efficiently maintained by well-advised expenditures from income for repairs and renewals—had to contend only with the views of the "Experts" who are retained and paid to depreciate the value of such investments, our task would be far less difficult to meet than is the fact. Unfortunately, the representatives of the public service corporations are not infrequently led astray on this question. Some are misled by their failure to differentiate between actual depreciation and the accrued and accruing liability for renewals in prospect. Others are not so misled but weakly argue that, as the commissions and courts take the position that "depreciation" should be deducted, they might as well conform to this position. How shall the commissions and courts be educated in this and many other complex matters involving questions in which the engineer and manager should be the instructor, if we meekly accept any and every hypothesis or theory which the commissions and courts are pleased to adopt? Not only is this not honest to the public service corporations, but it is not honest to the commissions and courts, for the honest members of these bodies have the right to look to us to educate them in matters more particularly pertaining to our profession.

Mr. Alvord, in the paper above mentioned, does claim to understand this question, and yet he admits that "depreciation" should be deducted unless a "sinking fund or a reserve fund for depreciation is actually kept in bank or in trust as part of the property," in which case "it should, if properly computed and accurately kept, receive the same rate of fair return as the remainder of the property 'used and useful for the public.'" Even though we may fail to agree with Mr. Alvord that "depreciation" should be deducted in the absence of such a specific fund, we can give him credit for a frank statement of his position. He acknowledges that such de-

preciation funds or trusts are not usually, if ever, maintained by our public service corporations, which means that, in his opinion, we must submit to deductions for estimated accrued liability for renewals of plant. These corporations are liable to stockholders, bondholders, and bankers for all of their capital. Should these liabilities also be deducted because they have not the money in bank to meet them?

The usual way in which depreciation reserve funds are invested is in extensions of plant. This part of the subject I have quite fully treated in my paper on "Depreciation: Actual and Estimated," above mentioned.

As an example of a very different treatment of this subject, and one much more dangerous than the one suggested by Mr. Alvord and those who think as he does, is the scheme so adroitly advocated by the influential and able Committee of *Consulting* Engineers responsible for the report to the American Society of Civil Engineers, above referred to. In Section 17 of its summary, the report says:

> "The sinking-fund method assumes that returns are to be based on the full value of an item of property, and that uniform annual payments will be made to a sinking-fund which is to be held intact, with accretions of interest until the end of the life of the item in question. This method does not meet the requirements of the courts in that they object to the establishment of sinking funds by public service corporations, and the highest court has decided that returns must be based upon the depreciated and not the full value of the property. Sinking-fund computations are used to determine the depreciation allowances of the Equal-Annual-Payment method, the allowances for each year being equal to the sinking-fund payment added to the interest on the accumulated fund at the beginning of the year."

In passing, I may suggest that because the highest court in our land has decided that a pressure of gas measured by a

column of water 2½ in. high will burst the ordinary cast iron gas main, we are not obligated to change our practice to conform to such a ridiculous proposition.

On page 39 of the report, we read as follows:

> "The sinking-fund method of computing depreciation allowances, as already stated, gives the same results as the Equal-Annual-Payment method, but the use of the words 'sinking fund' appears to have misled some courts and commissions so that they have objected to the depreciation allowances so computed, on the ground that the method involved the creation of a sinking-fund to be kept intact until the replacement of the property at a later time."

Again, in the Table of Contents of the report, we find:

> "Rates based on Depreciated Values the same as those based on Full Values."

Mr. Alvord apparently means to meet the question of deduction for "depreciation" frankly, although, as I see it, he falls into serious errors. On the other hand, he finds that my discussion of his paper is of an "unpersuasive tone." One of the points he particularly criticises is my endorsement of C. F. Mathewson's illustration of the hen laying eggs—the price of the eggs not to be reduced because of the hen's increasing age. Mr. Alvord says:

> "Like a good many illustrations that do not illustrate, this is misleading in that it is not comparable with the actual conditions as we find them, for, to make the illustration comparable with ordinary utility problems, we should imagine that the hen lays more eggs as time goes by than she did originally, and is at the same time growing old."

Evidently Mr. Alvord has failed to take in the full meaning of this very simple and fully applicable illustration, which in no

way involves the poor hen in such an unfair demand as to efficiency in egg-laying.

This committee of my fellow members of the A. S. C. E., while no doubt honest in their recommendations, certainly appear to be "whipping the devil round the stump." The Equal-Annual-Payment method, which is recommended by this committee as a way to get what we want as to return on investment, while appearing to meet the objections of the courts, consists in assuming a certain average life of plant; then taking for the annual depreciation allowance an amount which, accumulating in a sinking fund at, say, 5 per cent. will give 100 per cent. in the assumed life; then adding, say, 5 per cent. to this amount for return on investment. The amount set aside for depreciation to *increase* each year on the compound interest basis and the per cent. of return to *decrease* a like amount so that the total will always be the same. The tables used to illustrate this ingenious scheme of "now you see it, now you don't" does work out to a total of 8.02 per cent. for each year of a twenty-year life, provided the assumptions are made of a 5 per cent. sinking-fund rate which requires 3.02 for a twenty-year life, and 5 per cent. return on investment. But it does not meet the requirement as indicated in the title when the sinking-fund rate and the rate of return vary—as is shown in their table where 5 per cent. is taken for the former and 7 per cent. for the latter. In other words, the amount charged against the rate-payer for "depreciation" is, for the first year of the twenty, 3.02 per cent., this being the requirement for a twenty-year sinking fund at 5 per cent. To this is added the 5 per cent. for return on investment, making a total of 8.02 per cent. The basis for the Equal-Annual-Payment claim is that year by year the charge for "depreciation" shall increase to correspond to the accumulations in such a sinking-fund until for the twentieth year the figure of 7.64 per cent. is reached; and by reason of this increase, *for which there is no warrant in actual conditions,* the committee proposes to deduct accrued depreciation in calculating return on investment. They say

in effect—give us the return in the form of "depreciation" allowance and we will deduct a like amount from the claimed return on investment. For instance, in the table referred to—for the twentieth year there is accepted 5 per cent. on only $7.64 instead of on $100; or .38 per cent. instead of 5 per cent. on $100; and this provided the 3.02 per cent. rate on the sinking-fund can be increased until it reaches 7.64 per cent. in the twentieth year.

Before passing on from this elaborately argued and exhaustively discussed report, I would like to draw attention to the fact that the committee endorses the position taken by Commissioner Maltbie, of Public Service Commission, First District, New York, in the case of the Queens Borough Gas & Electric Company, in which the Commissioner treated the annual appreciation of land as *profit*; a most extraordinary proposition in the first place, and extraordinary again, that a committee composed of such eminent engineers should have endorsed it. Evidently the committee, when it wrote its report, was not aware that the Appellate Branch of the New York Supreme Court, in the Kings County case, reversed Commissioner Maltbie on his unique proposition to transmute appreciation in land value into income. The Court said:

> "So long as the land is held and used for such purpose, increase in value cannot be considered as income and available for the payment of debts, taxes and dividends."

Apart from the question whether "depreciation" is to be computed for the purpose of setting up a reserve or for establishing the basis for deduction from value new, the methods to be employed are of fundamental importance. Space does not permit at this time a comprehensive discussion of this feature of "depreciation." But I do wish to enter an earnest protest against the methods pursued by not a few "Valuation Engineers"; namely, in following, more or less blindly, tables of average lives for the several types and parts of plant. When

we reflect that these tables, if founded upon actual facts at all, are the result of averaging widely differing data, we should be able to see that no such average is applicable to a specific case, though it might be of value in connection with generalizations. The fact is, I presume, that these tables are, as a rule, not the average of actual results, though they may be the average of differing opinions.

It stands to reason that the life of plant must, in the first place, vary with its design, quality of material employed, and the way in which the parts are fashioned and put together. Later, the life must depend upon the way in which it is employed and the way in which it is maintained. Further, in the case of two items of the same design, from the same maker, of high quality and in every way standard—even the lives of these two pieces of plant will vary with the service demanded and the care, intelligence, and technical ability employed in its upkeep.

This feature of our problem has attracted the attention of the Railroad Commission of California. "In the Matter of Ascertaining the Value of the Property of the Stockton Terminal and Eastern Railroad Company within the State of California," we find on page 790 of the Opinions and Orders for the first half of 1913, the following:

> "In estimating the present value in this case, the Commissions, Engineering Department made a careful investigation into the average life and salvage value of the different classes of material and labor, using the *straight line method* of depreciation. The table used by the engineering department as applicable to the facts of this case is as follows":

Then follows, under the heading

"Average life (years)":

Trestles, bridges, 10; Culverts, C. I., 16; Redwood ties, 16; Rails, new, 25; Rails, relay (1910), 15; Frogs and Switches, 25; Track fastenings, etc., 12½; Ballast, 10;

Roadway tools, 10; Fencing, 15; Station buildings, etc., 10; General office furniture, 20; *Other structures,* 10."

In the text and the quotations from the table, the underscoring is mine.

In the report "In the Matter of Ascertaining the Value of the Property of the Santa Maria Valley Railroad Company", decided June 29th, 1914, we find the following:

> "The following table shows the average life attached to the several classes of labor, materials and property, and salvage value, if any, their estimated annual depreciation, and their depreciated value on the percentage of basis 'new' *for this line.*"

Then follows, under the heading

"Average life (years)":

> "Timber trestles, 10; Timber box culverts, 8; Corrugated iron culverts, 15; Wrought iron pipe, 25; Ties, Oregon pine, 8; Rails, new, 25; Rails, relay, 11 yrs. old, 14; Frogs, etc., new, 15; Frogs, etc., relay 6 yrs. old, 9; Railroad crossings, 5; Track fastenings, new, 15: Track fastenings, relay, 11 yrs. old, 10; Ballast, driftsand, 2; Roadway tools, 10; Fencing, 15; Crossings and signs, 10; Station buildings, 20; Shop buildings, 20; Shop machinery, etc., 20; Water stations, 25; Fuel stations, 20; Miscellaneous structures, 10."

Here we find a fairly close agreement between these two tables, notwithstanding the statements that the lives assumed are "applicable to the facts of this case" and "for this line," respectively.

"In the Matter of Ascertaining the Value of the Property of the Tonopah and Tidewater Railroad Company within the State of California," as quoted from Opinions and Orders for the latter half of 1913, at the bottom of page 215 and the top of page 216, we read as follows:

> "Timber structures and ties. The Engineering Department in its original report used its *average depreciation figures* in estimating the depreciation of timber structures

and ties of the railroad company. It appears that the department was in error in applying these average percentages to the conditions of the present railroad for the reason that the life of timber in the locality traversed by this railroad company is considerably longer than the average in other localities. A reinspection of the ties, timber and telegraph poles shows that while they are from five to seven years old, no evidence of decay appears either above or below ground. . . . The depreciation from wear is less than on *average railroads,* for the reason that only two trains daily run over the track. In view of these facts, and taking into consideration maintenance and renewal, the engineering department has prepared a revised estimate raising the percentage of present condition to condition new, as follows:"

In passing, we might raise the question—What is an "average railroad"?

The engineering department was also called upon to raise its estimates on "present value" on rails, ballast, track-laying, and surfacing.

Here we find that the commission begins to recognize that averages have to be accepted with some caution.

Again, we find that the commission in a number of cases has used widely varying percentages for the depreciation in wrought iron pipe. For instance,

	Per cent.
In the case of town of Taft investigation	8.0
In the case of Santa Maria Valley Railroad	4.0
In the case of California Natural Gas Company	1.9

Now that this commission has started to reform its "average" methods, may we not hope for still further progress in the right direction; and may we not also hope that other commissions and "Experts" may take the hint.

If "average life" figures are to be used, for our protection we must know in detail how they are obtained.

In the cases just referred to we note that the "straight line" method of depreciation has been followed.

Let us assume the following data as accepted for the computation of the "average life":

Parts of plant	Expectation of life in years	Cost new in dollars
A	10	25,000
B	15	50,000
C	25	100,000
D	35	150,000
E	50	175,000
Totals	135	500,000

It might be claimed that no such range in expectation of life would be found in the case of any one class of parts of plant. In my opinion this range might obtain in the case of classes of plant so broadly taken as in these California cases. But in any case, the principle applies. Presumably the cost of each part is not used as a function in arriving at the average; if it were, there would be no occasion for computing an "average," as each part could then just as well be treated separately. Apparently, then, the average is found by dividing 135 by 5, the former the total years, and the latter the number of cases included. This gives 27 years as the "average life."

In estimating and computing "depreciation" for the purpose of "Depreciation Reserve", it will be found convenient to set up a life-table, so avoiding a separate computation for each item of plant. In this table, while the items should be grouped according to the assumed expectation-of-life, this should be without regard to the character of the item.

For instance, instead of grouping all buildings together under a certain expectation-of-life, they should be grouped under their several respective expectations-of-life, as determined by expert examination.

Not infrequently in the effort to include the cost or load in dollars for each life, another very palpable error has been made, as follows:

Parts (a)	Years (b)	Cost of parts (c)	Col. (b) × Col. (c) (d)
A	10	25,000	250,000
B	15	50,000	750,000
C	25	100,000	2,500,000
D	35	150,000	5,250,000
E	50	175,000	8,750,000
		$500,000	$17,500,000

The last column is taken, erroneously, as representing the dollar-years. Dividing the 17,500,000 by 500,000, we get 35 years as the "average life", a result far from the truth.

The simplest way to get the true average life by the straight-line method is as follows:

Parts (a)	Years (b)	Costs (c)	(c) ÷ (b) (d)
A	10	25,000	2,500
B	15	50,000	$3,333\frac{1}{3}$
C	25	100,000	4,000
D	35	150,000	$4,285\frac{5}{7}$
E	50	175,000	3,500

Total annual charge for "Depreciation" $17,619

Dividing 500,000 by 17,619 = 28.378, the correct average life.

The question has been asked—Where is the fault in the method which gives the 35-year result? The explanation is that the "dollar-years" do not include all the dollars involved in the computation, for the reason that only one renewal is included for each part, whereas the renewals within the 50-years cycle run from 1 to 5, as shown in the following table:

Parts (a)	Years (b)	Cost of parts (c)	Times renewed in 50 yrs. (d)	Total requirement in 50 yrs. Col. (c) × Col. (d) (e)	Dollar years Col. (e) × Col. (b) (f)
A	10	25,000	5	125,000	1,250,000
B	15	50,000	$3\frac{1}{3}$	$166,666\frac{2}{3}$	2,500,000
C	25	100,000	2	200,000	5,000,000
D	35	150,000	$1\frac{3}{7}$	$214,285\frac{5}{7}$	7,500,000
E	50	175,000	1	175,000	8,750,000
		500,000		880,952	25,000,000

Dividing the total dollar-years by the total dollars to be provided in the 50 years period, we have as the "average life": 25,000,000 ÷ 880,952 = 28.378, which checks with the direct method shown above.

In passing, we may be reminded that in the case of the Sinking Fund method of providing for "depreciation," the *so-called* average life will vary with each rate of interest used in computing the Sinking Fund. For instance, on the life table above employed, the average life, *so-called,* would be for Sinking Funds; at 6 per cent., 27.05 years; 4 per cent., 27.73 years; 2 per cent., 28.2 years; and, as we have seen, 0 per cent., 28.378 years. In examining the several differing "average life" figures computed from this particular table, it may be remarked that the difference between the figure found by neglecting the dollar loading, and the correct figure including the several loadings, is not great, the first being $135 \div 5 = 27$ years, and the second being $500{,}000 \div 17{,}619 = 28.378$ years. But let us see how this comparison would appear if we maintained the same life for each part and the same total cost, but varied the cost as between the parts.

Let us take the table as before as to years, but reverse the separate cost amounts as follows:

Parts	Years	Cost of parts
A	10	175,000
B	15	150,000
C	25	100,000
D	35	50,000
E	50	25,000
	135	$500,000

Of course, the "average life" as found by dividing the total years by the number of lives included is the same as before, namely, $135 \div 5 = 27$ years.

If we include the cost of only one renewal during the 50 years, we have the following:

Parts (a)	Years (b)	Cost of parts (c)	Col. (b) × Col (c) (d)
A	10	175,000	1,750,000
B	15	150,000	2,250,000
C	25	100,000	2,500,000
D	35	50,000	1,750,000
E	50	25,000	1,250,000
		$500,000	9,500,000

Dividing the 9,500,000 by 500,000, we have 19 years, as compared with 35 years derived from the original table, and both incorrect as failing to include the total expenditures during the 50-year cycle.

To determine the correct average life from the amended table, we have by the direct method:

Parts (a)	Years (b)	Cost (c)	(c) ÷ (b) (d)
A	10	175,000	17,500
B	15	150.000	10,000
C	25	100,000	4,000
D	35	50.000	1,428$^{4}/_{7}$
E	50	25,000	500
		Total annual charge for "Depreciation"	33,428$^{4}/_{7}$

500,000 ÷ 33,438 = 14.96 years, instead of 28.378 years from the original table; both correct for the table as given, in both cases the same lives and the same total cost, but the costs varied as to the several parts.

If we use this amended table to show the total expenditures during the 50 years, to compare with the like table previously given, we have

Parts (a)	Years (b)	Cost of Parts (c)	Times renewed in 50 years (d)	Total required in 50 years Col. (c) x Col. (d) (e)	Dollar years Col. (e) x Col. (b) (f)
A	10	175,000	5	875,000	8,750,000
B	15	150,000	$3^{1}/_{3}$	500,000	7,500,000
C	25	100,000	2	200,000	5,000,000
D	35	50,000	$1^{3}/_{7}$	71,428$^{4}/_{7}$	2,500,000
E	50	25,000	1	25,000	1,250,000
		500,000		1,671,428$^{4}/_{7}$	25,000,000

25,000,000 ÷ 1,671,428$^{4}/_{7}$ = 14.96,

again checking up with the result obtained by the direct method shown in the next preceding table. Of course, the results as found in this last table could be obtained by multiplying the amounts in Col. (c) in each case by 50, but the table as given better shows the reason why.

The following table summarizes the results above shown and gives a better opportunity to make direct comparisons as to variations in results that are likely to occur in the use of

"average life" figures by the use of the same data as to life while neglecting or improperly applying the cost or dollar load; all for "straight-line" "depreciation":

	"Average life" as found by not including costs	"Average life" as found by incomplete inclusion of costs	Average life including costs Direct method computed from annual expenditures	Average life including costs computed from total expenditures
First life table....	27	35	28.378	28.378
Amended table...	27	19	14.96	14.96

It is to be noted particularly that the "average life" as frequently employed, neglecting costs of several parts, necessarily remains the same—a complete demonstration of the absurdity of employing "average life" data so obtained.

It is also to be noted that the so-called average life, as referred to in sinking fund computations, will not agree with the correct average life as shown in the last two columns, the "average life" decreasing as the sinking-fund rate of interest increases.

Coming back to the question whether "depreciation" should be deducted from plant valuation, let me refer to a number of homely illustrations which have been used in supporting the negative of this proposition. I have barely referred to the hen and egg illustration, in connection with which Mr. Alvord took me to task on the score that it is one of those "many illustrations that do not illustrate."

In a paper read before the convention of Railway Commissioners in October, 1913, by Dr. A. F. Weber, Chief Statistician of the New York Public Service Commission, First District, appears the following:

> "When that contention is made [not to deduct for estimated 'depreciation'], I always feel like asking whether a grindstone that is owned by a traveling scissors grinder is worth 100 per cent. of its value after it has been half worn out. Of course, it may do its work just as efficiently as a new grindstone, but certainly the peddler could not obtain 100 per cent. of the value (and by that I mean the cost) after the grindstone has been half worn out."

I note that Dr. Weber, even if he "always feels like asking this question," here asks it of an audience already committed to his proposition.

If Dr. Weber asks the question of me, I reply that the grindstone would not bring as much as a new one if the scissors grinder should attempt to sell it; but if he is to stay in the business, he will continue to use the grindstone until he has to buy a new one because the present one has become inefficient; and, in the meantime, he must provide currently for the cost of a new grindstone in his charges for grinding. This he can do without making any reduction in his charges by reason of the aging of the grindstone, for, as Dr. Weber says, "Of course, it may do its work just as efficiently as a new grindstone." Those who entrust their scissors to this man do not know and do not care how much or how little the grindstone has been reduced from its original diameter. They do care, however, as to how well the scissors are ground. The scissors grinder is not peddling grindstones; he is selling his services.

I quote again from Dr. Weber's paper:

> "In a memorandum on 'Depreciation in its Relation to Value' recently submitted to a commission by the attorney for a lighting company involved in a rate case, he declared that the opinion of the United States Supreme Court in the leading case of Knoxville vs. Knoxville Water Company should not be interpreted to the effect that 'accrued depreciation must be deducted from reproduction cost new in order to ascertain the fair present value of depreciable tangibles,' and then went on to say that 'The subject of depreciation as affecting values has never been presented adequately to any rate-fixing tribunal. As a consequence there have been conclusions which are absurd. To use a homely illustration—It is as if it had been determined that the price which a farmer is entitled to receive for his milk should be measured by the unexpired, normal, useful life of the cow from which it is drawn.' The illustration is a most unfortunate one for the argument

against the deduction for depreciation in determining fair value, because age is a very material factor in the price or selling value of a *cow*. Nowadays, when a milch cow is kept in the dairy only 4 or 5 years, a farmer who could be induced to give up as much money for a 6-year-old cow as for a 2-year heifer would not continue long in business unless he had some property still unencumbered on which he could borrow funds. The mere fact that the attorneys who argue public utility rate cases are usually city men who have forgotten all they ever knew about cows and horses, seems hardly sufficient to explain their attitude, because the automobile that carries them on their daily round of business and pleasure is a standing protest against their ingenious sophistries. I have yet to meet the lawyer who is willing to pay as much money for a used car as for a new car."

I quite agree with Dr. Weber that a "most unfortunate argument" is here presented, but I do not agree with Dr. Weber as to the person responsible for the "unfortunate argument."

In the above quotation I have underscored the word "cow." The farmer is not selling the cow; he is selling the milk. The gas company is not trying to sell its gas plant to the consumer; it is trying to sell gas.

I am, perhaps, in a better position to face Dr. Weber's biting sarcasm (?) for the reason that I do not and never have owned an automobile, but I do own quite a number both of horses and cows. The attorney quoted in this pertinent illustration was not considering the price or value of cows, but he was considering the price or value of milk. The farmer must get such a price for his milk that he will have in reserve enough to buy a new cow, or heifer, when the present cow permanently dries up or is not longer profitable or safe as a milker; and in the meantime he will go on charging the same price for his milk—that is, for his service to the milk buyer. He will not charge a graded price for the milk according to the age of the cow which produces it. Nor should we

charge less for our gas because our plant is aging and being renewed periodically, *and so being periodically made young again.*

Dr. Weber is afraid the poor farmer would get into financial difficulties if he paid as much for a 6-year-old cow as for a 2-year heifer. I agree with Dr. Weber. But nobody proposes anything approaching such a transaction. I do think, however, that the farmer would certainly get into difficulties if he lowered the price of his milk each year as his cow increased in age.

Dr. Weber and Mr. Alvord are here in accord, and they are in accord, perhaps, through different motives or causes.

Dr. Weber inferentially accuses the lawyer quoted as employing in his argument "ingenious sophistries." Was it sophistry or was it dense ignorance which moved this same Dr. Weber to prepare a revised statement of the income and expense of a certain gas company, in which he deducted taxes and "bad bills" from the expenses, so increasing the profits, and also secured a larger divisor for arriving at the cost per 1,000 ft. of gas sold, by including the intersales of gas between the several companies of the system, which gas had only been made once and could only be sold once?

The eminent engineer, H. P. Gillette, in an article which appeared in *Engineering Contracting* for December 3, 1913, discusses, with marked reasonableness, the question now before us. Let me quote one paragraph which should be convincing to the mind not pre-occupied by technicalities to the exclusion of justice and common sense:

> "It should be conceded by all, that justness and reasonableness of rates depends not altogether upon the mere intrinsic or even second-hand value of a property, but also upon its value to the public by reason of use,—therefore, if a property is well maintained and serves the public adequately and comfortably, can its value for rate-making purposes be affected by the fact that the rails are 5 years old, or that the cars have been in use for several

years? To admit this, would be utterly at variance with all logic and reason. For if such were the case, a new rate schedule would of necessity be filed every day, and the passenger traveling between his home and the down-town district would pay a smaller rate of fare each day, owing to the fact that the property used in transporting him would be gradually growing older. Thus, the absurdity of considering the depreciated value as a basis of rate-making is clearly indicated; and after the establishment of the fact that a property is in good operating condition, the question of depreciated value may be entirely dismissed."

When we find, as we do, such difficulty in making ourselves understood to the Commissions and even to their "Experts," we naturally ask—Where can we look for improvement? One suggestion has been that there should be on each of our public service commissions at least one competent engineer. I think that this would be helpful, and this I say notwithstanding the fact that I have in this paper shown that I completely disagree, as to the question before us, with such prominent engineers as Mr. Alvord and the members of the Special Committee of the A. S. C. E. On this subject, also, I have written before at some length, and I have had to face criticisms even from engineers. It should, of course, be understood that I do not claim that every engineer could be found competent to meet the duties and responsibilities of membership on a public service commission any more than I believe that every lawyer is qualified to fill a position on the bench.

Whether taken from our profession or from any other profession or vocation for membership on one of these commissions, a man should have an intense, over-mastering desire and determination to hold even the scales of justice; and should be imbued with the saving quality of common sense. He should be temperamentally qualified to hold fast to the fundamentals of truth. The engineer selected for this position should also be qualified technically and practically through

education in theory and training in the school of experience. He should, particularly, have had a wide experience as a designer, constructor, and *operator*. A man who has designed and constructed engineering plants, and has not had to operate these plants, may be a weak reed to lean upon, for his work has not been tested under his own eye as to results. It is easy to give advice if you do not have to make good yourself. That is the case of many consulting engineers and "Experts" who go astray on such questions as the one before us. A man to fill really the position of membership on one of these boards should have had a wide experience as an administrator, and should be open-minded enough to consider and weigh fairly evidence by other engineers. The type of engineer I refer to could do this certainly better than a layman, even outside of his particular specialty.

While writing on this subject recently, I was interested to come across an expression of view on this very same subject by Judge C. A. Prouty, formerly Chairman of the Interstate Commerce Commission, and now Director of Railway Valuations. Let me conclude this paper by quoting Judge Prouty from an address delivered in March of this year, before the American Railway Engineers Association. Perhaps I do not agree with Judge Prouty as to every detail of his statement, but I do agree with him fully within the limitations I have set forth above. The quotation is as follows:

> "In the last 15 years the price of every article of universal and general consumption, with one exception, has advanced, and that exception is transportation by rail. [How about gas and electric current?] If transportation by rail alone has not advanced, it is because railway engineers, by providing a better way and a better machine to operate upon that way, have rendered it possible to make economies which have offset the increased cost of labor and of supplies. The United States is about to enter upon a work of very great consequence, and the railway engineers are identified with that work. The problem is not altogether an engineering problem. It smacks of econom-

ics and of law and of politics, but the business of ascertaining and collecting a great part of the information is peculiarly a task of the engineer's, and I am not certain but the engineer may finally turn out to be the best qualified of all to consider the other problems.

"Now, when I began this work I was told that an engineer would measure and figure with accuracy, but that he was not competent to discuss the intricate problems presented by the valuation of our railroads, and that we must be very careful not to let him undertake to discuss them. I am fast coming to the conclusion that he may be better qualified than anybody else to discuss them. I have been a lawyer all my life, and I believe that my profession is the greatest of all professions, but I am obliged to admit, and I think I have said this before, that the training of a lawyer does not fit him for the discussion of questions of this kind. A lawyer by his training is a partisan. If you go back to the law school you will find that he is given a certain thing to affirm, and it is his business to make out that case. In life he has one side of a controversy, and he must establish that his side is right.

"The engineer is entirely different. He begins in school with mathematics. There is but one answer to a problem in mathematics. It may be hard work to find it, but there can never be two answers. When the engineer gets into life, it is still his business to find the fact, and just according as he can find the fact and be certain of the fact, he grows. If an engineer designs a bridge, and that bridge falls, his reputation falls with it. He cannot call in the undertaker and bury his blunder, as the doctor does. He can't charge it to the stupidity of a court, as the lawyer does. He must assume the burden of it himself. So I say that the very training of the engineer fits him for that precise kind of thinking which is essential in the working out of these new problems where absolute impartiality is necessary."

(Dr. Humphreys read an abstract of his paper and made the following remarks:)

Dr. Humphreys: The title of my paper is, "In Rate-Fixing by Commission, Should 'Depreciation' be Deducted from Plant Valuation?" You will notice that it is a definite question which I am endeavoring to answer, to get away from much of the ambiguity from which this subject of "Depreciation" (in quotation marks) has suffered. I will also say that unless there is some special case, some special reason for not doing it, every time that the term "Depreciation" is used in this paper, it appears in quotation marks, simply because I do not propose to make myself responsible for the loose use of a term which is often a misnomer.

The report of this special committee of the American Society of Civil Engineers (see page 1557), composed of some of its most prominent members, with the discussion to date, is, I believe, the most comprehensive and the most complete discussion of the subject of "Depreciation" that has been published to date. With this report should be read the other papers presented to the same society, as mentioned in my paper. I am inclined to think that there is no other institution which has covered this most important subject so completely, pro and con. The effort on the part of the prominent members composing this committee seems to have directed to the development of a scheme which would give protection to honest investment, and at the same time, would meet what they believed to be the views of the courts. It is a case, as I say in my paper, of "Now you see it and now you don't." Some of us have entered into the discussion at great length; I believe my discussion alone occupies some 45 pages of the record, and I have not done with it yet.

If Mr. Maltbie's extraordinary proposition (see page 1566) should by mischance be made law, in place of dividend checks, the poor stockholders would have to get what satisfaction could be extracted from reading a copy of the journal entry charging Real Estate account with the hypothetical increase in real

estate value and crediting same to Income; cold comfort for a hungry family.

On page 1574, when Dr. Weber states, "Of course, it may do its work just as efficiently as a new grindstone," he apparently does not see what he is admitting.

Before sitting down, I want to say that, of course, in making this abstract, I have barely touched upon the arguments I have tried to establish in the paper itself. I do not flatter myself that the paper has been read, and, therefore, I have to be satisfied with presenting it in this abbreviated form. (Applause.)

THE CHAIRMAN: Referring to the Sectional Nominating Committee, I will ask Mr. F. T. Hulswit to serve on that Committee.

A number of men are prepared to discuss this question, but it has been deemed advisable to have another paper read before the discussion is opened. We are very fortunate in having with us Mr. Halford Erickson, of Madison, Wis., a member of the Wisconsin Railroad Commission, who has won the admiration and the confidence of gas men. I have very great pleasure in presenting Mr. Erickson, who will speak upon the question of "Depreciation Problems."

DEPRECIATION PROBLEMS.

This paper deals mostly with the financing and the accountancy of depreciation and with certain questions that are involved in distinguishing between depreciation and ordinary repairs. Such phases of depreciation as its nature, the necessity of providing for it, the method of determining the life of the property have been touched upon, but not discussed at length.

Of all the subjects that have been brought to light and discussed, especially in connection with the regulation of public utilities, none has presented a more fruitful field for differences of opinion than is the case for depreciation. The discussions that have been carried on upon this subject and the facts that have been brought out concerning it, however, have lead to a

fairly general settlement of some of its fundamental features. For instance, depreciation is now quite generally said to represent that loss of value and efficiency in property and equipment which is due to wear and tear, to age or general decay, and to inadequacy and obsolescence. It is also generally acknowledged that these losses are proper charges to the operating expenses and should be covered by the earnings and that they should be considered in connection with the valuation of the property.

In providing for depreciation the general practice is to cover that part of it which is represented by wear and tear by direct charges to the repair accounts. While such depreciation as is due to age or general decay, inadequacy and obsolescence is sometimes provided for in advance by reservations from earnings, and at other times again by charging the cost of renewing or replacing discarded units of property directly to the operating expenses.

There is still considerable dispute as to how depreciation should be measured or determined. Some depend on life tables of such property as that involved; others again upon their own judgment in the matter, based on the inspection of the property and the operating and other local conditions. While these methods will not be discussed at length, here, it may be said that both are important. Life tables properly kept, classified and used throw a great deal of light upon the question. This may also be said of personal inspections of the property and the conditions by which its life is affected. Especially is this true when the inspections are made by competent parties. The best and most satisfactory way, however, is to use both methods. The use of life tables should be supplemented by actual inspection and vice versa. In addition to this liberal use should also be made of all other facts that have any bearing upon the question. In this way, it is usually possible to determine with a fair degree of accuracy the probable life of each class of property. That the life of the property should be determined as accurately as possible is also of the

greatest importance, for upon it are fixed the amounts that are allowed for depreciation.

The rate of depreciation thus depends upon the life of the property and is therefore higher for property with a short life than for property with a longer service life. The life of the property depends upon its nature, the character of the use that is made of it, whether it is kept up by ordinary repairs, and many other conditions. Repairs not only prolong the life of property but they maintain its efficiency for operating purposes. Charges for depreciation when based on the life of property kept up by such repairs are therefore not likely to be large enough to cover the cost of depreciation when repairs are included therein. Under this method of financing depreciation therefore it is necessary to make separate provisions with which to meet the cost of necessary repairs.

The fact that depreciation as well as ordinary repairs are proper charges to the operating expenses has not always been generally recognized. Not infrequently have renewals of all kinds been charged to the construction accounts and paid for by the proceeds from the sales of additional security issues. The fallacies involved in this, however, which become apparent when such practices are viewed in the light of settled economic theories, are gradually becoming more generally recognized. Only in exceptional cases, such as the destruction of property due to unforeseen and undeserved calamities or causes, and under highly abnormal conditions in certain other respects, might it be justifiable to temporarily charge renewals or replacements to capital.

While depreciation is constantly going on, the outlays for renewals are irregular and often relatively large. These outlays are in fact of such nature that for most plants they cannot be evenly distributed from year to year. In order to prevent serious fluctuations in the operating expenses and in the net earnings it is therefore best to provide for depreciation in advance through regular annual charges against earnings, which charges are adjusted as closely as possible to the rate at

which depreciation is accrued. Larger plants, such as railways, are often in position to so adjust their renewals that the cost of the same remain fairly constant from year to year. In such cases it may not be necessary to provide for depreciation in advance, since the cost of the renewals can then be charged directly to the operating expenses. Under this practice, however, there is often a great deal of accrued depreciation that is not offset by assets in some form. Without reserves of some sort, the investment cannot be kept intact.

Several methods are proposed for financing the accrued depreciation. The most important of these and the ones which seem to be best adapted to public service properties operating under regulation are the straight line and sinking fund methods. These have been explained and their use illustrated.

It will thus be assumed in this discussion that depreciation is to be set aside on either the "straight line" or "sinking fund" basis. According to the straight line method the annual allowance for depreciation is arrived at by dividing the cost new less scrap value of the depreciable property of each group by the estimated life of that group. The sum total of the allowances for all groups will give the total annual amount necessary. The rate of depreciation according to this method is therefore obtained by dividing this total annual allowance necessary to cover the depreciable property for the plant as a whole by the cost new less scrap value of all the depreciable property of the plant. Under the sinking fund method it is assumed that the amounts allowed for depreciation are invested at compound interest at a given rate, and that this interest also goes to make up the annual provision for depreciation. Since, in this case, the element of interest as well as the principal becomes part of the annual provision for depreciation, it necessarily follows that the annual charges to operating expenses need not be as large as would be the case if no interest allowances were included. The annual allowance necessary for each group of property is derived by multiplying the cost new less scrap of each group by a rate per cent. gotten from

sinking fund tables. The sum total of the allowances for all groups will give the total annual amount necessary exclusive of interest. By dividing the total annual allowance by the cost new less scrap of all the depreciable property the rate per cent. will be obtained.

The procedure under either method is approximately the same. Only from an accounting viewpoint is there any distinction worth noting; under the straight line method the annual allowance for depreciation is obtained from only one source, or from charges to the operating expenses alone; under the sinking fund method the annual allowance is obtained from two sources, or partly from charges to the operating expenses and partly from the interest received for the use of depreciation balances.

Arguments to the effect that under the sinking fund method in order that interest may be had for the use of the balances for depreciation it is necessary to segregate the amounts set aside for depreciation into a reserve fund do not seem to be supported by the facts. For instance, there does not seem to be any good reasons why assets offsetting the depreciation reserve can not be as effectively employed for interest earning purposes as balances in the depreciation reserve fund. All that is necessary to that end in either case is that such assets and balances are in such form as to be available for use, and that opportunities are offered for their profitable employment. The confusion upon this point is probably due to failure to note the differences that exist between the sinking fund method of providing for depreciation and sinking fund requirements for the retirement of bonds.

It is an open question from a business point of view whether it is advisable to establish a depreciation reserve fund at all. In order to establish such a fund it is necessary to transfer to it the cash or other assets that are held against the depreciation reserve. Further, in order that interest may be earned on the assets so transferred it is necessary that the balance in the fund be placed at interest or temporarily invested in such a

way that it will be readily available when needed for renewals. As the depreciation assets or balances can be as well, if not better, used or invested while standing as offsets to the depreciation reserve as after they have been transferred into the reserve fund, the creation of a reserve fund will only place a few additional restrictions upon the use of these balances. It will probably result in this: that the amounts set aside for depreciation will in part find their way into the reserve fund and in part be held as offsets to the reserve account. Whether the provisions for depreciation are placed in the reserve fund or merely treated as offsets to the reserve account would not seem to be of vital importance. This is at any rate the case when the affairs of the plant are properly managed.

The amounts thus set aside for depreciation, however, while held awaiting the use for renewals, should be advantageously employed. For such employment the opportunities are often numerous, but none would seem to be more advantageous and economical from a business point of view than those which are offered by such extensions to the plant as are needed from time to time, often annually. Such employment of the reserve assets enables extensions to be made even under adverse financial conditions when capital might not be obtainable in any other way. It is also as a rule fairly well secured against extra ordinary risks, and besides is likely to bring better returns than could be obtained elsewhere. It must be understood, however, that such use of these assets in the plant should not be considered permanent investment, but rather in the nature of a loan, and that whenever needed for renewals the loans so made must be returned to the reserve or fund. The use of assets offsetting the reserve for plant extensions therefore merely postpones the time when additional capital securities must be issued for the cost of these extensions. Security issues for such purposes and under such conditions are in fact capital issues, and should be so regarded. As such loans thus tend to defer, sometimes for years, the issuing of capital securities for new extensions they also defer the interest pay-

ment thereon and hence often result in considerable savings to the plant from this source.

It would even seem that for a permanent plant owing to the fact that its cost new less depreciation will always remain much less than its cost new, a part of the amount set aside to keep the investment intact might be permanently withdrawn and returned to the investors. Such return of a part of the investment, however, would amount to about the same thing as the withdrawal of an equal proportion of the capital invested, and would therefore reduce the basis upon which the returns for interest and profits should be allowed. It would also alter the basis upon which the depreciation allowances are computed, especially under the sinking fund method. While such withdrawal of a part of the capital might be practical, it is so closely connected with other conditions that it is doubtful whether in the end it would be in line with the best policy.

The assets offsetting the depreciation reserve may also at times be profitably used as additional working capital and for other more or less temporary purposes in the operation of the plant. When such assets are in such form as to permit it, there are also times when for most plants it is not only more convenient, but less costly to borrow for current use from these assets than from the banks. Instances in point might easily be mentioned were this thought necessary.

It is of course necessary for utility managers to use discretion in determining how much of the depreciation reserve should be represented by plant, and how much by other assets of various kinds. Care should be taken that the policy adopted in this respect is not one that will injure the service. The amounts for depreciation are contributed by the consumers through the rates they pay for the service, and the consumers as such are entitled first of all to reasonably adequate service. Any use of the moneys for purposes through which the service is impaired is in direct violation of the principles which justify an allowance for depreciation, and should be avoided. Whether

the amounts set aside for depreciation should be placed in a reserve fund or merely kept as offsets to the reserve account would seem to be questions that largely depend upon the character of the management and the circumstances under which the plant is operating. For some plants the former course may be the best; for other plants again the latter. There are also likely to be plants whose interests are best protected when a part of these assets are placed in the reserve fund and a part employed for current purposes.

Since under the sinking fund method of providing for depreciation it is necessary that the balance held for such depreciation until needed for renewals be so used or invested as to bring in something in the way of interest, the question arises as to the basis upon which such interest should be figured. In thus determining upon how interest is to be figured there is much to be taken into consideration. In the first place it cannot often be safely assumed that the entire balance can always be so used as to earn interest. If any part of it remains idle from time to time as it is almost certain to do at least for shorter periods, the interest is reduced by that much. Then again, the question of the safety of the loan or investment must be taken into account. Balances of this kind should not be placed in risky undertakings even if this means lower returns for interest. Small risks and low rates of interest usually go together. The rates of interest paid on deposits by banks and trust companies do not exceed 3 or 4 per cent., depending upon the time involved. First class bonds and mortgages readily convertible into cash, yield but little more than this. Depreciation balances, because of the circumstances involved, are likely to yield even lower rates than those given. In view of these and other facts it is not safe to assume that such balances will regularly bring more than from 2 to 4 per cent. on their entire amount.

The interest thus received from the balances held for depreciation should be as carefully accounted for as any other part of the business. In the income account, for instance,

such interest accretions may be shown both as non-operating revenues and as deductions from gross income. When presented in this form they can be fully taken into the accounts without affecting the net earnings from operation alone.

Since depreciation is an operating expense, it should also be charged to operating expenses, and such charges to these expenses should be made in monthly or other periodical allowances. When regularly charged up in this way there is also likely to be a fairly close agreement between the sum of these charges and the amount of the depreciation that has taken place in the property.

That depreciation in a broad sense includes repairs is also evidenced by the fact that it is the purpose of depreciation to keep the cost of the property intact. For it is obvious that the integrity of the investment can not be maintained through depreciation allowances alone unless these allowances are also large enough to cover such losses as those which are made up by repairs. While it is suggested herein that depreciation and repairs should be kept apart these suggestions do not mean that it is believed that these items cannot be properly dealt with if combined into one. On the contrary such combinations might be practicable not only in the provisions that are made for these costs, but in the expenditures of these provisions.

Nevertheless, there are certain advantages in keeping depreciation and repairs apart that should not be overlooked. Such practice seems to be more natural and therefore more easily understood. It would seem to enable closer estimates of the respective costs of these items than can be had in any other way. It tends to facilitate the closest practicable adjustment between the depreciation that has taken place in the property and the reservations made to offset such depreciation. It also appears to be more advantageous from other points of view.

Should it be desirable to do so, it is also practicable to apply the reserve account principles to repairs without including

them in depreciation. All that it is necessary to do to that end is to treat repairs in about the same manner as that in which depreciation is treated when provided for in advance. It is doubtful, however, whether any such practice as this for repairs alone could with any advantage be generally adopted.

While much has been said about how the repairs may be determined and distinguished from depreciation, few thorough going studies of these questions appear to have been made in which the operating, the engineering and the accounting features involved were given due consideration. These questions, however, are so important that they should be made the subject of special studies not only by industries, but by individual plants.

The terms "repair" and "maintenance" have been used interchangeably, although in the generic sense they are not the same and a proper distinction might be made between them. The accounting classification of the Railroad Commission of Wisconsin defines maintenance as follows: "Maintenance should be understood to mean 'up-keep,' and should cover all expenditures for current or ordinary repairs, renewals or replacements of property resulting from wear and tear, or through those casualties which are incidental to the nature of the operation and which expenditures are necessary in order to keep up the productive capacity of the plant to its original or equivalent state of efficiency." Gradually, however, renewals or replacements chargeable to maintenance shade over into renewals or replacements chargeable to depreciation. This is pointed out in the following citation also derived from the Wisconsin Commission's classification of accounts: "When, however, a complete replacement of any building or structure or unit of equipment is made necessary regardless of such current expenditures, the uncurrent or extraordinary repairs, renewals or replacements made necessary will be charged to the Depreciation Reserve accumulated for that purpose."

These definitions, it is realized, are open to criticism because they leave unanswered the questions as to just what

items constitute "repairs," "replacements," "complete replacements," etc.

In the endeavor to arrive at a distinction between them that is general in its scope, efforts have been made to determine what common consent thus far seems to regard as depreciation on the one hand, and repairs or maintenance on the other, and what some of the controlling elements are in each case.

The verbs most frequently used in discussing this question are maintain, repair, renew, replace and their derivative nouns. These terms are defined by Webster as follows:

> Maintain—"To hold or keep in any particular state or condition, especially in a state of efficiency or validity."
>
> Repair—"To restore to a sound or good state after decay, injury, dilapidation or partial destruction."
>
> Renew—"To make new again; to restore to existence."
>
> Replace—"To supply an equivalent for."

While all of these terms may be said to relate to efficiency, the terms renewal and replacement are broader than the terms maintenance and repair. The term renewal for instance would seem to represent the substitution of a new unit of the same kind as the old one. Replacement, on the other hand, is a term that would seem to cover the substitution of a new unit for an old one when the new unit is equivalent though not of the same kind. Maintenance and repairs appear to cover the up-keep of minor units and of minor parts of the larger units of equipment, and these two terms are therefore used interchangeably.

From these definitions and from the nature and purpose of depreciation and of maintenance or repairs the inference may be drawn that the terms renewals and replacements represent the larger changes such as the putting in of entire units of equipment in place of old units which have had to be discarded either because of general decay, or because of inadequacy or obsolescence; and that maintenance or repairs cover mostly

such minor changes and repairs on the larger units as are necessary in order to keep up their efficiency during their normal service life, or until they must be discarded for such reasons as those just given. The cost of renewals and replacements as thus explained are proper charges to depreciation. The cost of maintenance or repairs as thus outlined are proper charges to repairs.

A few facts which further illustrate the difference between depreciation and repairs may also be given. Thus, the upkeep of bearings on machines, wheels on cars, tires on wagons, shoes on horses, commutators on dynamos are properly classed as maintenance or repairs, while the putting in of a new machine, a new car, a new horse, and a new dynamo for the old one is properly classed as renewal or replacement, or as depreciation. Repairs, therefore, consist of renewing minor equipment and minor parts of the larger units of equipment. Depreciation covers the renewal or replacement of the larger units themselves. The object of repairs in most cases is to maintain the efficiency of apparatus without replacing the apparatus itself. The wearing out and the destruction of minor units or of minor parts of the larger units goes on with much regularity and the cost of such wear and destruction can for this reason be charged directly to the operating expenses without causing undue fluctuations therein. In other words, since the outlays for repairs are fairly constant, they need not be provided for in advance through the building up of reserves for this purpose.

If the normal life of the different units of property is assumed to be the life which obtains when the units are kept up by ordinary repairs, then it also follows that such normal life is not after all greatly affected by repairs, but that it may be indefinitely prolonged by renewals. When the situation is viewed in this light many differences between repairs and depreciation may be discerned. In fact, they then lead to the inference that repairs should include all charges necessary in order to maintain the efficiency of the property or units up to

the time when it has to be renewed either because of general decay or because of inadequacy and obsolescense.

For the purpose of further illustrating the theories upon which the above distinctions between repairs and depreciation are based they have been applied to a concrete case. A manufacturer in order to produce a necessity has just completed the construction of his plant. He has paid $10,000 for the land required and he has placed that amount into his capital account as an amount upon which he is entitled to earn interest and profit. The construction of the plant required in addition an expenditure of $80,000 for labor and materials. This amount too has been added to the capital account, making his investment $90,000. Of his total investment thus far, the plant alone representing an expenditure of $80,000 is subject to a lessening in value. The plant will depreciate due to wear and tear, it will depreciate with age, it will become inadequate and it will become obsolete. In order to operate efficiently he requires in addition $5,000 for working capital and $5,000 for materials and supplies. The working capital and materials and supplies are continuously being used up in the production and sale of the commodities, but the manufacturer finds that he must keep that much working capital and materials and supplies continuously on hand in order to be able to meet all emergencies. Consequently he has added $10,000 to his capital account thus making his total investment $100,000. He hires the necessary labor and begins operations. At the end of his first year of operations his gross sales amounted to $80,000. His expenses for wages and raw materials and supplies used up in production amount to $55,000, leaving $25,000 with which to reward the services of his fixed capital investment. He finds that during the year, although he did not renew his plant in any important detail, an expenditure of $4,500 was necessary for ordinary repairs to offset the wear and tear of the plant and keep it up to its original running efficiency. He finds further that if he had invested an equal amount of money in a similar enterprise he would have de-

rived as interest and profit upon such investment $12,000. In his calculations he therefore regards this amount as his cost of capital. He finds further that during the year he has expended $500 for the renewal of equipment originally included in his investment of $80,000 for plant. This is an expenditure he had not anticipated. It makes him think that perhaps his major equipment, although at present in good running order, will have to be completely renewed. He begins to investigate and finds that he will have to renew all of his major equipment at the end of ten years. In the course of his investigations he finds too that the $500 expended for renewals will recur again the next year. The net result of these findings is that for the ten years during which the plant costing $80,000 is operating, there will be required a regular annual expenditure of $500 and in addition expenditures amounting to $79,500 at the end of ten years or an average of $8,000 annually.

This situation will serve to illustrate the economic significance of the separation between depreciation and repairs. The amount of $4,500 required in making minor renewals of major units of equipment which themselves will not be retired until later on is a pure operating cost and must be charged as an operating expense continuously. It is an expense incurred to preserve the usefulness of this equipment. It may be regarded somewhat in the nature of an insurance charge against inefficiency which must be met as it accrues. The amount of $500 representing the renewals of equipment the life of which is short is not a repair but a depreciation charge which with the rest of the depreciation charges must be met each year to keep intact the investment.

The illustration it seems should indicate where the distinction between repairs and depreciation lies. A depreciation charge is always accompanied by a hypothetical or actual retirement of the capital assets. Since it is necessary to properly account for all current and capital costs accruing within a financial period, such period being usually a year, repairs,

on account of their regular occurrence, are charged to the year during which they are made, while depreciation is charged only insofar as it has actually or potentially occurred. Due to the fact, however, that potential depreciation requires separate financing, the actual depreciation or that represented by minor yearly renewals, is combined with the charges for repairs.

Thus far I have tried to point out what the theoretical distinction is between repair charges on the one hand and depreciation charges on the other. To properly apply the distinction it will be necessary to define what constitutes a unit of equipment, the complete renewal or replacement of which is a charge to depreciation.

From a tangible or engineering standpoint, property may be classified as continuous or discontinuous. Continuous properties are such as from their very nature are never completely renewed at one time. Street railway tracks, the pole lines of electric or telephone utilities and the distribution mains of gas or water utilities are examples of continuous properties. Discontinuous properties may be entirely or only partially renewed at one time. Machinery, rolling stock, and structures of all kinds are familiar examples of discontinuous properties.

I have already explained why the renewal of discontinuous properties lasting less than the customary period is for convenience classed as a repair charge. In making complete or partial renewals of discontinuous properties lasting longer than the customary accounting period, judgment based on the distinctions previously drawn will have to be exercised. Because depreciation has been accruing against the life expectancy of the old unit with the view of creating a new life expectancy in new units, such a renewal cost may properly be charged to depreciation. The renewal of only a part of a discontinuous property would ordinarily be a charge to repairs unless the life expectancy of that part of the property has been increased and will not have to be renewed again when

the life expectancy of the remaining part of the same property has expired.

In making renewals or replacements of continuous properties, it is difficult to say what shall constitute a unit. The best policy would seem to be to consider as a unit the substitution of any section of such structures, regardless of length and regardless of the cost. If this is not done, there are only two courses open. One is to fix an arbitrary limit which is undesirable because unscientific, and the other is to charge all renewals and replacements to repairs unless the entire continuous property is affected. Since the entire continuous structure is never renewed or replaced at any one time, the repair accounts would carry all these replacements with the final result that the depreciation allowance has failed to serve its purpose altogether.

The illustrations given above indicate in a general way the distinctions which obtain between depreciation and repairs. A depreciation charge is, as a rule, offset by a hypothetical or actual retirement of some unit of property or equipment and is supposed to be set aside at about the same rate as it has been estimated that the depreciation it covers will accrue. Repairs, on the other hand, being of more regular occurrance, are charged directly to repairs or maintenance as made or as found necessary. Depreciation reserves are accumulating against the life expectancy of existing units. Repair charges seem to consist of the current allowances that must be expended in order that this expected life of the units may be realized.

Losses or depreciation of property due to fire or accidents or to other causes than those given for depreciation and repairs must, as a rule, be covered either by insurance, special reserves, or direct charges against earning. Such losses are not supposed to be covered by the usual depreciation and repair allowances.

Property which is not continuous in the sense in which this term is used here may be said to consist of buildings, boilers,

engines, generators, arc lights, rolling stock, etc. In illustrating what is depreciation and what are repair charges for a unit of this kind, an alternating current generator of about 200 kw. capacity costing about $2,600 may be taken as an example.

The useful life of such a generator is usually about 20 years so that the depreciation on a straight line basis, disregarding its scrap value, is 5 per cent. or $130 per year. The provision of $130 per annum is the annual expense of meeting the cost of the inevitable renewal or replacement of the unit when it shall be no longer suitable for operation. This allowance is not sufficient, however, to also keep the machine in working order during the period of its usefulness. It will be found that from time to time minor deficiencies develop in the generator which when repaired will restore the working efficiency of the machine. The cost of such attention is designated as "repair" and is charged directly to the operating accounts.

The original cost of the generator which we have taken as an example may be roughly divided into the following component parts:

Foundation	$200
Base	75
Frame	200
Core	200
Armature coils	1,000
Bearings	50
Bearing pedestals	75
Shaft	100
Rotor:	
Spider or rotor frame	200
Fields or magnets	200
Collecting rings and brushes	25
Pulley	75
Total above	$2,400
Miscellaneous	200
	$2,600

It is ordinarily discovered upon examination of a piece of

equipment that certain parts are subject to wear and tear while others are quite exempt from these causes. It is natural therefore that the elements or parts of equipment which are affected by wear and tear are also those upon which money must be expended for repairs while the remaining parts occasion little or no expense for up-keep during the entire life of the machine. Such is the case with the generator. The foundation, base, frame, core, pedestals and rotor frame are very rarely subject to any repairs except occasional painting to keep up the good appearance of the plant. Armature coils and field windings, however, are subject to electrical and mechanical strains and it is not unusual that whole coils or several coils must be renewed or reinsulated. Bearings also wear out, melt from friction and heat, and must be replaced; shafts become worn in the bearings and must be returned; collector rings become loosened or their insulation defective and must be repaired; pulleys become cracked or broken from strain and oil and must be replaced. There are also other miscellaneous repairs to insulated conductors, screws, bolts, cement work, etc., which cannot very well be listed separately. All these matters are an expense in the operation of the generator, but the renewal of the parts does not seem to change the identity of the whole nor prolong its normal life.

The repairs noted above for the generator in question, while not the same from year to year, may be estimated as follows for the entire period of its usefulness.

Armature coils	$200
Bearings (replaced several times)	200
Shaft (re-turning)	20
Field windings	50
Collector rings and brushes	10
Pulley	75
Total above	$555
Miscellaneous	145
	$700

The repairs, therefore, in this instance amount to about 27

per cent. of the cost of the article or to $33 per year, which is very nearly 1.4 per cent. of the value.

In the foregoing example, the line between "repair" and "depreciation" may be quite easily drawn because it is not difficult to see that the renewal of any of the parts of a generator does not prolong the useful life materially although its normal usefulness is sustained. When the generator is finally retired it is not to be expected that the parts renewed will be more usable than the foundation, frame or core. The situation is somewhat different with other equipment which we sometimes consider to be a unit. An arc lamp with its supporting equipment, having a useful life of 12 years, may be mentioned as illustrative of this difference. The arc lamp complete and installed would cost about as follows:

1 Lamp	$20.00
1 Hanger board	3.25
100 ft. 5/16 in. galvanized wire	.91
1 Sleet-proof pole pulley	.40
1 Sleet-proof suspension pulley	.85
100 ft. ½ in. Manila rope	1.24
100 ft. No. 6 weather-proof copper wire	1.79
2 2-pin 3 ft. cross arms	.24
2 Oak pins	.02
2 Glass insulators	.08
Labor	1.25
	$30.03

If the glass globe of the arc lamp has to be replaced, its regulating coils or feeding mechanism repaired, almost every one would agree no doubt that the cost should be classed as "repairs" and charged directly to operation. On the other hand, if the whole lamp were in such decrepit condition that a new one must be installed, then it is also clear that this would be a depreciation charge. The same rule appears to apply also to the hanger board, though with less force. When, however, consideration is given to the renewal of many of the other items comprising the arc lamp support, the border line between repair and depreciation is reached and doubt arises as to

which way to proceed. We must then rest our conclusion upon whether the part renewed continues to perform service as an integral part of other equipment when the equipment of which it now forms a part is eventually discarded. Upon this basis, it appears that the renewal of the arc lamp and hanger board constitutes a depreciation charge; but repairs of lamp and hanger board parts, and renewal of galvanized supporting wire pulleys, Manila rope, copper leads to the lamps, cross arms, pins and insulators constitute a repair charge. Such repairs during the life of the lamp may be estimated as follows:

Lamp repairs	$3.00
Hanger board repairs	.25
Pulleys	.75
Rope	1.50
Pins and insulators	.10
Total above	$5.60
Miscellaneous	.75
	$6.35

The repairs in this instance amount to 21 per cent. of the original cost and are equal to 1¾ per cent. per year while depreciation alone amounts to over 8 per cent. per year.

An analysis along the lines indicated in these illustrations is now being conducted by the Railroad Commission of Wisconsin. The results of this investigation while necessarily imperfect and subject to amendment will, it is hoped, lead to further study and observation of the problem by the operators themselves so that at least a beginning will have been made in the endeavor to separate expenditures for repairs from expenditures for depreciation.

It will perhaps be said that the distinctions between depreciation and repairs which have thus been outlined are too general to shed much light upon the subject. It may be said further that the situation upon this point is not materially improved by the statement that depreciation is a capital cost while repairs is a current operating cost. In answer to this it may be pointed out that what properly constitute repairs is a ques-

tion that varies not only between different industries, but between different plants in the same industry, and that for this reason no general rules can be laid down that fully cover the distinction in each specific case. All that can be done in this respect in a paper like this is to outline the theories upon which the distinction rests and to illustrate in a general way how these theories should be applied. The actual determination in each particular case of what items should be charged to depreciation is a matter that must be left to the manager, the engineer and the accountant.

Before leaving this subject I should like to speak a word of warning to those who would perhaps be inclined to accept the separation of maintenance expense into repairs and depreciation without further inquiry. The question is still an open one; and while the subject has here been treated as though a distinct line of demarcation may be found, further investigation especially in connection with discontinuous properties, may reveal such difficulties that the attempt will have to be abandoned and repair and depreciation charges merged. When the accounts are merged there will be certain changes with respect to the handling and allowance of these expenditures and their entry upon the books. The annual allowance for maintenance will have to be increased so as to include both repair and depreciation allowances. Moreover, since the repair accounts now contain a miscellaneous lot of expenditures the combination of these with depreciation will require a multiplication of accounts which shall be definitely related to the properties which are being maintained.

This brings us to the question of the bookkeeping machinery that is necessary to properly record on the account books of the plant all the transactions involved in providing for depreciation and in removing and renewing the discarded property. In this connection some understanding of the meaning and purpose of some of the leading accounts is of importance. Unfortunately the terminology of depreciation accounting does not seem to be fully standardized. Three accounts, however,

are of special importance in connection with depreciation and these accounts are "Depreciation," "Depreciation Reserve" and "Depreciation Reserve Fund."

Depreciation.—This is the operating expense account to which the annual estimated depreciation is charged. This account should show the charges for depreciation that enter into the cost of the service and that are intended as an offset to such depreciation as has taken place in the plant and equipment.

Depreciation Reserve.—This account is credited with the amount set aside for depreciation and which as stated is charged to the depreciation account. It is also credited with the amounts received as interest for the use of the balances held for depreciation. This account appears either on the right hand side of the balance sheet among the plant liabilities, or as a deduction from property and plant. If correctly kept, the balance in this account measures the lessening in value of the plant and equipment caused by the various forms of depreciation. The "Depreciation Reserve" account is thus designed to show the amount that has been reserved from earnings to cover depreciation. The balance in this account represents the difference between the total amount reserved and the charges made to this account for the renewals of property. The reserve account on the right hand side of the balance sheet is on the debit side of the balance sheet offset by the various forms of assets that have resulted from the reserves set aside for depreciation.

Depreciation Reserve Fund.—This is an asset account and always appears on the left hand side of the balance sheet. It is charged with all the assets especially set aside for depreciation and transferred to the fund and debited when these assets are withdrawn for renewals. This reserve fund account may thus contain cash securities and other items of value that can be used for the replacement of worn out equipment or property. The assets included in the fund may thus equal all or only a part of the assets represented by the depreciation

reserve, depending upon what proportion of the latter have been transferred to the fund. When these transfers cover all the assets reserved for depreciation then the balance in the depreciation reserve fund should agree with the amount of accrued depreciation not covered by renewals.

The accounting principles thus outlined insofar as they relate to depreciation proper or when repairs are not included therein have been further explained in Appendices I and II, which are attached hereto. In Appendix I the different journal entries that are required in properly entering upon the books of the plant the various transactions involved in dealing with depreciation are more fully analyzed and illustrated. The purpose of this is to indicate in some detail what entries are required in this connection and how they should be made. This appendix is an essential part of this paper.

In Appendix II the principles that have been outlined are applied to actual transactions of a hypothetical plant for a period of five years. The transactions in this case cover not only the construction and extensions of the plant, but the provisions for depreciation and the renewal of the discarded property. The entries involved are explained and illustrated as well as posted to actual accounts. The accounts thus involved consist of a controlling account of the property of the plant, and of four minor property accounts. In addition to this there are also such accounts and financial statements as Accounts Payable, Interest, Receipts from Operation, Balance Sheet, Depreciation Reserve, Capital Stock, Cash, Depreciation and Income Account. While these accounts do not differ in principle from those ordinarily kept, they have been named and treated more in line with what was deemed best for illustrative purposes than in accordance with prevailing classifications and practices. These facts should be borne in mind by those who may happen to examine them.

These accounts have also been kept upon the cost basis. That is, the property accounts have been charged with the original cost of the property and of the extensions to the same

as well as with the cost of the renewed property, and credited with the original cost of the property discarded or taken out. Under this method the balance of the property accounts at any given time should show or agree with the actual cost of the property then in use. Whether this cost is greater or less than the cost of the original property would therefore depend upon whether the cost of the property renewed was greater or less than the cost of the original property. Prices or costs are almost constantly changing and this is also true of the equipment and of the methods of operation.

In cases where all or part of the property has been renewed it is therefore likely that the cost of the property in use will differ from the cost of the original property. The original cost of the plant and the cost of its property now in use are important elements in all appraisals of such plants and it is therefore of the greatest importance that the accounts should be so kept that these costs are fully disclosed. It is partly in order to emphasize this fact and to show that it is possible to so keep the accounts that the elements in question are disclosed, that the following tables which show not only the cost of the original property, but of the property in use at the end of the period are included.

Referring to the table in this series which is headed property summaries, it appears that the original cost of the properties first installed and of the properties installed as additions was $157,500. In renewing these properties it was found that savings amounting to $4,000 were effected because the cost of units of equal capacity had meanwhile decreased. The actual cost of the units now in place and rendering service is, therefore, less than the original cost by the amount of this saving, or $153,500.

TABLES ILLUSTRATING DIFFERENCES BETWEEN ORIGINAL COST AND ACTUAL COST.

Original Investment.

Group A	$ 5,250
Group B	15,750
Group C	31,500
Group D	52,500
	$105,000

	First year			Second year		
	Additions	Retirements	Renewals	Additions	Retirements	Renewals
Group A	.....	.....	.....	.....	$5,250	$5,250
Group B	.....	.....	.....	.....	.....	.....
Group C	$5,250	.....	.....	$5,250	.....	.....
Group D	5,250	.....	.....	5,250	.....	.....
Total	$10,500	.....	.....	$10,500	$5,250	$5,250

	Third year			Fourth year		
	Additions	Retirements	Renewals	Additions	Retirements	Renewals
Group A	$5,250	.....	.....	.....	$5,250	$5,250
Group B	5,250	$15,750	$18,750	$5,250	.....	.....
Group C	.....	.....	.....	5,250	31,500	29,500
Group D	.....	.....	.....	.....	.....	.....
Total	$10,500	$15,750	$18,750	$10,500	$36,750	$34,750

	Fifth year			Total five years		
	Additions	Retirements	Renewals	Additions	Retirements	Renewals
Group A	.....	$5,250	$5,250	$5,250	$15,750	$15,750
Group B	$5,250	.....	.....	17,750	15,750	18,750
Group C	.....	5,250	5,250	15,750	36,750	34,750
Group D	5,250	52,500	47,500	15,750	52,500	47,500
Total	$10,500	$63,000	$58,000	$52,500	$120,750	$116,750

Property Summaries.

	Original cost	Net retirements	Actual costs
Group A	$10,500	.....	$10,500
Group B	31,500	$3,000*	34,500
Group C	47,250	2,000	45,250
Group D	68,250	5,000	63,250
Total	$157,500	$4,000	$153,500

* Net additions.

APPENDIX I.

The bookkeeping entries that are required in accounting for depreciation are comparatively simple. The methods of determining the annual charges to operating expenses both under the straight line and sinking fund methods have been outlined above, and this amount divided by twelve will give the monthly charge. The monthly or other periodical charge having been determined, a journal entry is made each month, or for such other period as the case may be, charging "Depreciation" and crediting "Depreciation Reserve" with the amount of the allowance. (Illustration I.)

CREATION OF DEPRECIATION RESERVE.

Depreciation ..... Dr. .....
To Depreciation Reserve..... Cr. .....
(Being the proportion charged monthly to operating expenses for depreciation and credited to Depreciation Reserve.)

This entry is identical in wording for both the straight line and sinking fund methods. The only point of difference is that amounts under the straight line method would be larger.

From the journal the items are to be posted to the proper accounts in the "General Ledger." When the financial statements for the month or period are made "Depreciation" is thus included in the Income Account as one of the classes of operating expenses to be deducted from revenues before net earnings are determined. The Depreciation Reserve balance is either included in the Balance Sheet among the liabilities of the plant or may be shown as a deduction from Property and Plant. The practice of carrying the Depreciation Reserve among the liabilities of the utility is the one favored by the Railroad Commission of Wisconsin.

The fact that the "Depreciation Reserve" account is credited when the "Depreciation" account is debited indicates the manner in which earnings are reserved for the lessening of the plant value or for depreciation. The total credits to the reserve indicate the amount that has been withheld from revenues to meet the element of depreciation.

Under the sinking fund method one entry is required monthly or periodically in addition to the one discussed above. This entry is a debit to "Interest" and a credit to depreciation reserve. (Illustration II.)

INTEREST COMPUTATION.

Interest (Depreciation Reserve Requirement) ..... Dr. .....
To Depreciation Reserve..... Cr. .....
(Being the proportion deducted monthly from gross income for interest under the sinking fund method, and credited to Depreciation Reserve, because money was borrowed by the plant from the reserve for extensions.)

The foregoing constitute the required entries on the books of the utility in providing for depreciation under both the straight line and the sinking fund methods. These entries are simple and direct and utilities should encounter little difficulty in applying them in actual operation.

The next group of entries relates to the renewal or the replacement of the depreciated property. The importance of providing for depreciation becomes fully apparent when the equipment becomes useless for operating purposes. In fact the full significance of a Depreciation Reserve is not realized until it becomes necessary to remove and replace the various units of the equipment. Before the new units can be installed the old units must be removed. When the renewals are made therefore the depreciation reserve should be charged and the proper plant account credited with the cost new of the unit removed. The same entries will apply when equipment is removed but not replaced, or when equipment is permanently abandoned as occasionally happens with gas and water mains. (Illustration III.)

PROPERTY REMOVALS CHARGED TO DEPRECIATION RESERVE.

Depreciation Reserve ..... Dr. .....
To Property and Plant..... Cr. .....
(Being the reduction of the appropriate property and plant account by the amount of the original cost of the equipment removed.)

The entry is illustrative for the removal of any class of equipment, building or fixture.

When equipment is renewed the cost of removing the old units should also be charged to "Depreciation Reserve" and credited directly to "Accounts Payable" and ultimately to "Cash." These entries need not be made through the Journal, but should be treated in the same manner as the other expense vouchers of the utility. The cost of removing the equipment should also be met from the amounts reserved for depreciation. These reservations therefore should be great enough to cover not only the cost of the renewals proper, but the cost of removing the discarded property as well. (Illustration IV.)

REMOVAL CHARGES.

Providing all costs were journalized the entries for the costs of removing the property and equipment would be as follows:

(1) Depreciation Reserve ..... Dr. .....
To Accounts Payable ..... Cr. .....
(2) Accounts Payable ..... Dr. .....
To Cash ..... Cr. .....

Advanced accounting methods require that all costs pass through Accounts Payable before affecting Cash. This is necessary in order to record expenses, etc., on the accrual rather than on the disbursement basis. In regular practice the above entries would not be made through the Journal, but the amounts would be carried directly to the Depreciation Reserve, Accounts Payable and Cash accounts from the records of original entry. This is for the purpose of eliminating much detail work. The accounting principles are the same as above, however, and the result would be exactly the same. The above method is used for simplicity of illustration.

The entire cost of the new units in replacement work is debited to "Plant" under the appropriate account in the same manner as plant extensions are charged under ordinary con-

ditions. The credit in this case will be first of all to "Accounts Payable" and ultimately to "Cash." (Illustration V.)

REPLACEMENT CHARGES.

(1) Property and Plant	Dr.	
To Accounts Payable	Cr.	
(2) Accounts Payable	Dr.	
To Cash	Cr.	

These entries are journalized for simplicity of illustration. In regular practice the entries would be made to the accounts affected directly from the records of original entry as the voucher, etc. This is for the purpose of eliminating much detail work. The necessity of passing all costs through Accounts Payable affecting Cash is that expense, etc., may be recorded on the accrual rather than on the disbursement basis.

The cost of the new unit, equal in value to the one removed, being covered by the reservation of past earnings for depreciation, should be paid for from the accumulations so reserved. If the cost of the new unit exceeds the cost of the one replaced, then such excess costs must be provided for in the same manner as other plant extensions are ordinarily provided for. This must necessarily be the case since the allowance for depreciation does not exceed the cost of the unit taken out.

When the equipment removed or taken out has value as scrap another entry is required on the books. In the determination of the amount to be reserved annually for depreciation it is customary to estimate the life of the equipment as well as its scrap value when taken out of service. Such scrap value reduces by its amount the sum that must be provided for depreciation. For the renewal of units (see Tables I and II) having a scrap value therefore the amount that should be charged to the depreciation reserve is the cost new of such unit less its scrap value. This result is obtained by charging the entire original cost of the unit to the depreciation reserve account and then in a separate entry credit the Depreciation Reserve account for the value of the scrap.

The old equipment may be disposed of in various ways. In

some instances it is sold as soon as the unit is knocked down. In other cases again it is taken into the storeroom either to be used again in the business or to be held until sold. In either case there should be a credit for its value to the Depreciation Reserve and a debit to Cash if the junk is sold for cash, or to Materials and Supplies if placed in stock. (Illustration VI.)

ENTRIES FOR SCRAP VALUE.

1. When the junk is disposed of for cash the following entry is illustrative:

Cash	Dr.	.....
To Depreciation Reserve	Cr.	.....

2. When the junk is placed in stock the entry would be as follows:

Materials and Supplies	Dr.	.....
To Depreciation Reserve	Cr.	.....

It may be advisable to enter the above transactions on the Journal, but this is not necessary. Entry 1 can be made directly in the Cash Book without passing through the Journal. Entry 2 can be entered on a voucher and posted directly from that source without passing through the Journal. The above entries, however, are illustrative of the principle.

The entries thus far described illustrate conditions where a Depreciation Reserve only is maintained without a Depreciation Reserve Fund.

In creating such a reserve fund as an offset to the depreciation reserve a check should be drawn for the amount involved and debited to the depreciation reserve fund and credited to cash. (Illustration VII.)

CREATION OF A DEPRECIATION RESERVE FUND ACCOUNT.

Depreciation Reserve Fund	Dr.	.....
To Cash	Cr.	.....

(Being the proportion transferred to the fund account to secure a reserve of a like amount.)

The presence or use of such fund account would also cause a

few changes in the entries that are required in connection with the removal of old property and the renewal of the same as well as with the scrap value. These changes consist mainly of substituting the reserve fund account for the cash account in a few instances as indicated in previous illustrations. The necessity for these changes arises from the fact that cash affected was transferred from the cash account to the reserve fund account.

APPENDIX II.

In order to more definitely explain how the accounts may be made to show the progress of theoretical depreciation, the renewals made to offset the same, and the maintenance and growth of the plant account, we have assumed a plant ready to begin operations, having a cost new of depreciable property of $105,000. The depreciation we will assume is to be financed on a 4 per cent. sinking fund basis. In this illustration we will of course assume ideal conditions so that the renewal periods will coincide exactly with the previously estimated length of life. In order to congest the illustration we will assume property having a relatively short life.

In order to furnish the capital required to obtain the plant we will assume that stock is sold for cash. All bills rendered for construction purposes will first be made to pass through Accounts Payable before being paid out of the cash account. The opening entries, neglecting the Stock Subscription account would be as follows:

Account	Dr.	Cr.
Cash	$105,000	.....
Capital Stock	.....	$105,000

Assuming that a controlling account is kept called plant investment and that the minor property accounts closing into the controlling account are denominated by their respective age groupings, as shown below, we may make the following entries in the Journal:

Account		Dr.	Cr.
Plant Investment		$105,000	.....
Group A	$ 5,250	.....	.....
Group B	15,750	.....	.....
Group C	31,500	.....	.....
Group D	52,500	.....	.....
Accounts Payable		.....	$105,000
Accounts Payable		105,000	.....
Cash		.....	105,000

In order that sufficient cash may be on hand in order to make renewals we will carry an account called "Receipts from Operation." To this account, because the plant is assumed to be normally successful, will be credited amounts sufficient to cover the annual allowance for accrued depreciation. When depreciation reserves are invested in plant extensions, as we will assume, the operations of the plant become responsible for interest which these amounts would have earned when invested outside the business. These earnings too will be shown in this account.

The amount required to cover the annual accrued depreciation is shown in the following table:

TABLE I.—Sinking Fund Method—4 Per cent.

Age group	Life in years	Cost new	Scrap value	Cost new less scrap	Annual fund
A	2	$ 5,250	$ 250	$ 5,000	$2,451
B	3	15,750	750	15,000	4,805
C	4	31,500	1,500	30,000	7,065
D	5	52,500	2,500	50,000	9,230
		$105,000	$5,000	$100,000	$23,551

During the first year of operation the accruing depreciation amounts to $23,551. Since it is not essential to the plan of depreciation that a fund be kept the entries for depreciation will concern themselves only with the Depreciation Reserve account. Interest will accumulate upon the investment of these amounts in plant extensions and will be shown as receipts from operations in the appropriate account.

JOURNALIZED TRANSACTIONS.

First Year.

Accounts	Dr.	Cr.
Depreciation	$23,551	.....
Depreciation Reserve	.....	$23,551
(Annual Depreciation Allowance)		
Cash	23,551	.....
Receipts from Operation	.....	23,551

It will be assumed further that the plant grows at a rate necessitating an investment of $10,500 per annum. These properties are all of a depreciable nature and belong 50 per cent. in Group C and 50 per cent. in Group D—Scrap Value $500.

The entries to be made in the Journal in accordance with these assumptions are the following:

		Dr.	Cr.
Plant Investment		$10,500	.....
Group C	$5,250	.....	.....
Group D	5,250	.....	.....
Accounts Payable		.....	$10,500
Accounts Payable		10,500	.....
Cash		.....	10,500

SECOND YEAR.

In order to estimate the accrued depreciation for the second year and the allowance to be made to cover the same Table II has been constructed.

TABLE II.—SINKING FUND METHOD—4 PER CENT.

Age group	Life in years	Cost new	Scrap value	Cost new less scrap	Annual fund
A	2	$ 5,250	$ 250	$ 5,000	$2,451
B	3	15,750	750	15,000	4,805
C	4	36,750	1,750	35,000	8,243
D	5	57,750	2,750	55,000	10,153
		$115,500	$5,500	$110,000	$25,652

This table shows that $25,652 must be set aside from the revenues of the second year to meet the accruing depreciation. In addition there has accumulated during the second year interest at 4 per cent. upon the amount set aside for de-

preciation at the close of the first year. These transactions should be evidenced by the proper entries in the Journal, as follows:

JOURNALIZED TRANSACTIONS.

Second Year.

Accounts	Dr.	Cr.
Depreciation	$25,652	....
Depreciation Reserve	....	$25,652
(Annual Deprec. Allowance)		
Interest (Deprec. Res. Requirement)	942	....
Depreciation Reserve	....	942

As already explained interest accretions to the depreciation reserve must, under the assumptions, be derived out of plant earnings. The same is true of the charge for depreciation for the current year. The following entry therefore becomes necessary:

	Dr.	Cr.
Cash	$26,594	.....
Receipts from operation.....	.....	$26,594

According to Table I property comprised in Group A will have to be renewed at the end of the second year. This will necessitate an expenditure of $5,250, part of which or $5,000 to be derived from the amounts set aside in the depreciation reserve and part to be derived from the sale of the retired units as scrap. We are assuming, of course, that all our estimates have been correctly made. Before the new units can be installed the old units must be removed. When the renewals are made therefore the depreciation reserve must be charged and the proper plant accounts credited with the cost of the unit removed. This is accomplished by the following Journal entry:

	Dr.	Cr.
Depreciation Reserve	$5,250	.....
Group A	.....	$5,250
Plant Investment	.....	$5,250

When equipment is renewed the cost of removing the old units should also be charged to "Depreciation Reserve" and

credited directly to "Accounts Payable" and ultimately to "Cash." The costs of removing old equipment should also be met from the amounts reserved for depreciation so that these reservations ought to be great enough to cover not only the cost of the renewals proper, but the cost of removing the discarded property as well. In order to simplify our illustrations and make them more brief we have purposely omitted this feature.

After the property has been removed it has a junk value of $250. We will assume that it is sold for that amount immediately upon its removal. Since we have charged the Depreciation Reserve Account with the entire original cost of the old units whereas we have only credited that account with the cost new less scrap value we must now credit that account with the scrap value. This is accomplished by the following entry:

	Dr.	Cr.
Cash	$250	...
Depreciation Reserve	...	$250

We are now ready to make the replacements of property in Group A. We will assume that the prices and cost of installing the property have remained exactly as they were when Group A properties were installed for the first time. The replacements having been made, we must record the same by means of the following entries:

		Dr.	Cr.
1. Plant Investment		$5,250	.....
Group A	$5,250	.....	.....
Accounts Payable		.....	$5,250
2. Accounts Payable		5,250	.....
Cash		.....	5,250

In accordance with our assumption as to the annual growth of the plant we must record an investment of $10,500, 50 per cent. of which is properly in Group C and 50 per cent. in Group D, Scrap Value $500. This requires the following entries.

	Dr.	Cr.
Plant Investment	$10,500	.....
Group C $5,250	.....	.....
Group D 5,250	.....	.....
Accounts Payable	.....	$10,500
Accounts Payable	10,500	.....
Cash	.....	10,500

THIRD YEAR.

In order to estimate the accrued depreciation for the third year and the allowance to be made to cover the same Table III has been constructed.

TABLE III.—SINKING FUND METHOD—4 PER CENT.

Age group	Life in years	Cost new	Scrap value	Cost new less scrap	Annual fund
A	2	$ 5,250	$ 250	$ 5,000	$2,452
B	3	15,750	750	15,000	4,805
C	4	42,000	2,000	40,000	9,420
D	5	63,000	3,000	60,000	11,075
		$126,000	$6,000	$120,000	$27,752

The above table has been derived from the similar table constructed the previous year and from the various property accounts. While the property in Group A has been retired, it has been immediately renewed without change in investment cost. Properties in Groups C and D have been increased by the additional investments made during the second year of operation. The amount to be set aside for depreciation is shown to be $27,752. In addition there has accumulated during the third year interest at 4 per cent. upon the balance in the depreciation reserve at the close of the second year. These transactions should be evidenced by the proper entries in the Journal, as follows:

	Dr.	Cr.
Depreciation	$27,752	.....
Depreciation Reserve	.....	$27,752
(Annual Deprec. Allowance)		
Interest (Deprec. Res. Required)	1,806	.....
Depreciation Reserve	.....	1,806
Cash	29,558	.....
Receipts from Operation	.....	29,558

According to Table I property comprised in Group B will have to be renewed at the end of the third year. This will necessitate an expenditure of $15,750, part of which or $15,000 to be derived from the amounts set aside in the depreciation reserve and part to be derived from the sale of the retired units as scrap. It frequently happens however that installing new units of equal capacity requires the expenditure of more money than has been provided because the price of the same has advanced or it may be found desirable to install units of greater capacity than the ones retired, again necessitating the expenditure of more money than has been reserved. We will assume that the plant is confronted with the former situation. We will assume that units of equal efficiency would now cost $18,750, an advance of $3,000. Before the new units can be installed the old units must again be removed and provision made to transfer the funds from the reserve account. This is accomplished by the following Journal entry.

	Dr.	Cr.
Depreciation Reserve	$15,750	.....
Group B	.....	$15,750
Plant Investment	.....	..... $15,750

The reason why both of the accounts "Group B" and "Plant Investment" are credited for the same amount is that the "Plant Investment" account is a controlling account and any entry credited to one of the subsidiary property accounts must also be credited to the controlling property account where all the subsidiary property accounts are summarized.

In order to realize the full value of the retired unit for replacement purposes it must be sold as junk. The entry would be:

	Dr.	Cr.
Cash	$750	...
Depreciation Reserve	...	$750

We are now ready to make the replacement of the property included under Group B. But the amount reserved for depreciation plus the scrap value is insufficient by $3,000 to pay

for the new units. Hence, an additional investment of $3,000 will be required. This is derived through Accounts Payable but must ultimately come out of Cash. The required entries are:

	Dr.	Cr.
1. Plant Investment	$18,750	.....
Group B	$18,750	.....
Accounts Payable	.....	$18,750
2. Accounts Payable	18,750	.....
Cash	.....	18,750

In accordance with our assumptions as to the annual growth of the plant we must again record an investment of $10,500, 50 per cent. of which is property in Group A and 50 per cent. in Group B, Scrap Value $500. This requires entries as follows:

	Dr.	Cr.
Plant Investment	$10,500	.....
Group A	$5,250	.....
Group B	5,250	.....
Accounts Payable	.....	$10,500
Accounts Payable	10,500	.....
Cash	.....	10,500

Fourth Year.

In order to estimate the accrued depreciation for the fourth year and the allowance to be made to cover the same, Table IV has been constructed.

TABLE IV.—Sinking Fund Method—4 Per cent.

Age group	Life in years	Cost new	Scrap value	Cost new less scrap	Annual fund
A	2	$10,500	$ 500	$10,000	$4,902
B	3	24,000	1,000	23,000	7,367
C	4	42,000	2,000	40,000	9,420
D	5	63,000	3,000	60,000	11,076
		$139,500	$6,500	$133,000	$32,765

The above table has been derived from the similar table constructed the previous year and from the various property

accounts. While the property in Group B has been retired it has been immediately renewed with an increase in the investment cost of $3,000. Property in Groups A and B has been increased by the additional investments made during the third year of operation. This is shown by the property accounts. The amount to be set aside for depreciation is shown to be $32,765. In addition there has accumulated during the fourth year interest at 4 per cent. upon the balance in the depreciation reserve at the close of the third year. These transactions should be evidenced by the proper entries in the Journal, as follows:

	Dr.	Cr.
Depreciation	$32,765	.....
Depreciation Reserve	.....	$32,765
(Annual Deprec. Allowance)		
Interest (Peprec. Res. Required)	2,388	.....
Depreciation Reserve	.....	2,388
Cash	35,153	.....
Receipts from Operation	.....	35,153

According to Table IV and the property accounts, the properties comprised in Group A renewed at the close of the second year of operation, will again have to be renewed at the close of this year's operations. Property comprised in Group C having a life of four years will also have to be renewed at the same time. This will necessitate an expenditure in the first case of $5,250 and in the second case of $31,500, part of these sums to be derived from the amounts set aside in the depreciation reserve and part to be derived from the sale of the retired units as scrap. In the case of the renewal of properties comprised in Group C it will be assumed that, as is sometimes the case, units of equal efficiency can be obtained at less than the original cost of the retired units. We will assume that this sum is $2,000 less than the first cost, thus making the sum required for renewals of Group C properties $29,500. Since the depreciation reserve has accumulated upon the basis of a cost of $31,500 there will be available $2,000, represented among the general assets, for repayment of capital investment.

Before the new units can be installed the old units must again be removed and provision made to transfer the funds from the reserve account. This is accomplished by the following Journal entry:

	Dr.	Cr.
Depreciation Reserve	$36,750	.....
Group C	.....	$31,500
Group A	.....	5,250
Plant Investment	.....	$36,750

In order to realize the full value of the retired units for replacement and capital repayment purposes, they must be sold as scrap. This entry would be as follows:

	Dr.	Cr.
Cash	$1,750	.....
Depreciation Reserve	.....	$1,750

We are now ready to make the replacements of the property included under Groups A and C. The required entries are:

	Dr.	Cr.
1. Plant Investment	$34,750	.....
Group A	$ 5,250	.....
Group C	29,500	.....
Accounts Payable	.....	$34,750
2. Accounts Payable	34,750	.....
Cash	.....	34,750

In accordance with our assumptions as to the annual growth of the plant we must again record an investment of $10,500, 50 per cent. of which is property in Group B and 50 per cent. in Group C, scrap value $500. This requires entries as follows:

	Dr.	Cr.
Plant Investment	$10,500	.....
Group B	$5,250	.....
Group C	5,250	.....
Accounts Payable	.....	$10,500
Accounts Payable	10,500	.....
Cash	.....	10,500

These Journal entries have been carried forward to the general ledger accounts affected, summaries of which are shown at the close of this appendix.

Fifth Year.

In order to estimate the accrued depreciation for the fifth year and the allowance to be made to cover the same, Table V has been constructed.

TABLE V.—Sinking Fund Method—4 Per cent.

Age group	Life in years	Cost new	Scrap value	Cost new less scrap	Annual fund
A	2	$10,500	$ 500	$10,000	$4,902
B	3	29,250	1,250	28,000	8,968
C	4	45,250	2,250	43,000	10,127
D	5	63,000	3,000	60,000	11,076
		$148,000	$7,000	$141,000	$35,073

The above table has been derived from the similar table constructed the previous year and from the various property accounts. The amount to be set aside for depreciation is shown to be $35,073. In addition there has accumulated during the fifth year interest at 4 per cent. upon the balance in the depreciation reserve at the close of the fourth year. These transactions should be evidenced by the proper entries in the Journal, as follows:

	Dr.	Cr.
Depreciation	$35,073	.....
Depreciation Reserve	.....	$35,073
(Annual Deprec. Allowance)		
Interest (Deprec. Res. Requirement)	2,394	.....
Depreciation Reserve	.....	2,394
Cash	37,467	.....
Receipts from Operation	.....	37,467

According to Table V and the property accounts, some of the properties comprised in Group A will have to be renewed at the close of this year's operations. These properties are those which were added as additional investments during the third year of operation and were taken into the books at the

close of that year. They represent an investment of $5,250 which we will assume can be renewed at the same cost price. Of the properties comprised in Group C those which were added as additional investments during the first year and taken into the books at the close of that year's operation will have to be renewed at the close of the fifth year. They represent an investment of $5,250 which we will assume can be renewed at the same cost price. Of the properties comprised in Group D those properties originally invested and amounting to $52,500 will have to be renewed at the close of this year's operations. We will assume that these properties can be renewed for less than their original cost, or $47,500. Since the depreciation reserve has accumulated upon the basis of original cost there will be available after renewals $5,000, represented among the general assets, for repayment of capital investment.

Before the new units can be installed the old units must again be removed and provision made to transfer the funds from the reserve account. This is accomplished by the following Journal entry:

	Dr.	Cr.
Depreciation Reserve	$63,000	.....
Group A	.....	$5,250
Group C	.....	5,250
Group D	.....	52,500
Plant Investment	.....	$63,000

Again in order to realize the full value of the retired units for replacement and capital repayment purposes, they must be sold and their value as scrap obtained. The entry is as follows:

	Dr.	Cr.
Cash	$3,000	.....
Depreciation Reserve	.....	$3,000

Ordinarily, the next step would be to make the necessary replacements. An examination of the cash account will show, however, that the funds are not available for making the re-

placements. There will be required for replacements $58,000, whereas the balance of the cash account shows only $57,323. The depreciation reserve account, however, indicates that funds to the amount of $100,323 have been set aside. The money should be on hand, however, because the accounts have been correctly kept. Obviously, if they are not in the cash account, they must be in plant. An analysis of our Plant Investment account should disclose therefore where the money has gone.

During the first year we find that $10,500 have been taken out of the cash account, money properly belonging to the reserve for depreciation, and therefore borrowed from it, in order to pay for the year's extensions. The same is true for the second year. During the third year, we find that not only have $10,500 been borrowed for extensions, but $3,000 additional were required above the original cost set aside in the reserve to renew properties in Group B. During the fourth year $10,500 were borrowed for extensions; but for the renewal of properties in Groups A and C, $2,000 less was required than had been set aside in the reserve. During the current year there will be required $10,500 for extensions, but for the renewals of properties in Groups A, C and D, $5,000 less will be required than has been accumulating in the reserve: It is very evident, therefore, that in order to keep the original investment intact, in order to return to the fund the amounts which have been borrowed, capital stock will have to be sold. If we had not used the reserve for plant extensions, the following amounts would have been required each year to finance them:

First year	$10,500
Second year	10,500
Third year	13,500
Fourth year	8,500
Fifth year	5,500
Total Requirements	$48,500

In arriving at the total shown in the above table it has been

assumed, and the assumption is in accord with the usual practice, that amounts set aside in the depreciation reserve, but not required for the renewals to which they are specifically applicable, instead of being returned to the investors, are kept in the business and applied to necessary extensions. When, therefore, we increase the capital stock, by the above figure, this, in effect, maintains the capital stock or proprietorship account on a par with the original cost value of the capital assets, or as in this case, the plant investment account. This entry would be as follows:

	Dr.	Cr.
Cash	$48,500	.....
Capital Stock	.....	$48,500

We are now ready to make the replacements of the property included under Groups A, C and D. The required entries are:

		Dr.	Cr.
1. Plant Investment		$58,000	.....
Group A	$ 5,250	.....	.....
Group C	5,250	.....	.....
Group D	47,500	.....	.....
Accounts Payable		.....	$58,000
2. Accounts Payable		58,000	.....
Cash		.....	58,000

In accordance with our assumptions as to the annual growth of the plant we must record an investment of $10,500, 50 per cent. of which is property in Group B and 50 per cent. in Group D, Scrap Value $500. The entries are:

		Dr.	Cr.
Plant Investment		$10,500	.....
Group B	$5,250	.....	.....
Group D	5,250	.....	.....
Accounts Payable		.....	$10,500
Accounts Payable		10,500	.....
Cash		.....	10,500

PLANT INVESTMENT ACCOUNT.

Dr.		Cr.
$105,000	Original Investment, Groups A, B, C & D, 1st yr.	
10,500	Additional Investment, Groups C & D, 1st yr.	
	Balance	$115,500
$115,500		$115,500
$115,500	Balance Investment, 1st yr.	
10,500	Additional Investment, Groups C & D, 2d yr.	
	Retired Investment, Group A, 2d yr.	$5,250
5,250	Renewed Investment, Group A, 2d yr.	
	Balance	126,000
$131,250		$131,250
$126,000	Balance Investment, all Groups, 2d yr.	
10,500	Additional Investment, Groups A & B, 3d yr.	
	Retired Investment, Group B, 3d yr.	$15,750
18,750	Renewed Investment, Group B, 3d yr.	
	Balance	139,500
$155,250		$155,250
$139,500	Balance Investment, all Groups, 3d yr.	
	Retired Investment, Groups C & A, 4th yr.	$36,750
34,750	Renewed Investment, Groups C & A, 4th yr.	
10,500	Additional Investment, Groups C & B, 4th yr.	
	Balance	148,000
$184,750		$184,750
$148,000	Balance Investment, all Groups, 4th yr.	
	Retired Investment, Groups A, C & D, 5th yr.	$63,000
58,000	Renewed Investment, Groups A, C & D, 5th yr.	
10,500	Additional Investment, Groups B & D, 5th yr.	
	Balance	153,500
$216,500		$216,500
$153,500	Balance Investment, all Groups, 5th yr.	

GROUP A—PROPERTY ACCOUNT.

Dr.		Cr.
$5,250	Original Investment, 1st yr.	
	Balance	$5,250
$5,250		$5,250
$5,250	Balance Investment, 1st yr.	
	Retired Investment, 2d yr.	$5,250
5,250	Renewed Investment, 2d yr.	
	Balance	5,250
$10,500		$10,500
$5,250	Balance Investment, 2d yr.	
5,250	Additional Investment, 3d yr.	
	Balance	$10,500
$10,500		$10,500
$10,500	Balance Investment, 3d yr.	
	Retired Investment, 4th yr.	$5,250
5,250	Renewed Investment, 4th yr.	
	Balance	10,500
$15,750		$15,750
$10,500	Balance Investment, 4th yr.	
	Retired Investment, 5th yr.	$5,250
5,250	Renewed Investment, 5th yr.	
	Balance	10,500
$15,750		$15,750
$10,500	Balance Investment, 5th yr.	

GROUP B—PROPERTY ACCOUNT.

Dr.		Cr.
$15,750	Original Investment, 1st yr.	
	Balance	$15,750
$15,750		$15,750

GROUP B—PROPERTY ACCOUNT.—(*Continued*)

Dr.		Cr.
$15,750	Balance Investment, 1st yr.	
	Balance	$15,750
$15,750		$15,750
$15,750	Balance Investment, 2d yr.	
	Retired Investment, 3d yr.	$15,750
18,750	Renewed Investment, 3d yr.	
5,250	Additional Investment, 3d yr.	
	Balance	24,000
$39,750		$39,750
$24,000	Balance Investment, 3d yr.	
5,250	Additional Investment, 4th yr.	
	Balance	$29,250
$29,250		$29,250
$29,250	Balance Investment, 4th yr.	
5,250	Additional Investment, 5th yr.	
	Balance	$34,500
$34,500		$34,500
$34,500	Balance Investment, 5th yr.	

GROUP C—PROPERTY ACCOUNT.

Dr.		Cr.
$31,500	Original Investment, 1st yr.	
5,250	Additional Investment, 1st yr.	
	Balance	$36,750
$36,750		$36,750
$36,750	Balance Investment, 1st yr.	
5,250	Additional Investment, 2d yr.	
	Balance	$42,000
$42,000		$42,000

GROUP C—PROPERTY ACCOUNT.—(*Continued*)

Dr.		Cr.
$42,000	Balance Investment, 2d yr.	
	Balance	$42,000
$42,000		$42,000
$42,000	Balance Investment, 3d yr.	
	Retired Investment, 4th yr.	$31,500
29,500	Renewed Investment, 4th yr.	
5,250	Additional Investment, 4th yr.	
	Balance	45,250
$76,750		$76,750
$45,250	Balance Investment, 4th yr.	
	Retired Investment, 5th yr.	$5,250
5,250	Renewed Investment, 5th yr.	
	Balance	45,250
$50,500		$50,500
$45,250	Balance Investment, 5th yr.	

GROUP D—PROPERTY ACCOUNT.

Dr.		Cr.
$52,500	Original Investment, 1st yr.	
5,250	Additional Investment, 1st yr.	
	Balance	$57,750
$57,750		$57,750
$57,750	Balance Investment, 1st yr.	
5,250	Additional Investment, 2d yr.	
	Balance	$63,000
$63,000		$63,000
$63,000	Balance Investment, 2d yr.	
	Balance	$63,000
$63,000		$63,000

GROUP D—PROPERTY ACCOUNT.—(*Continued*)

Dr.		Cr.
$63,000	Balance Investment, 3d yr.	
	Balance	$63,000
$63,000		$63,000
$63,000	Balance Investment, 4th yr.	
	Retired Investment, 5th yr.	$52,500
47,500	Renewed Investment, 5th yr.	
5,250	Additional Investment, 5th yr.	
	Balance	63,250
$115,750		$115,750
$63,250	Balance Investment, 5th yr.	

ACCOUNTS PAYABLE.

Dr.		Cr.
$105,000	Construction—Groups A, B, C & D	$105,000
10,500	Additions—Groups C & D, 1st yr.	10,500
$115,500		$115,500
$5,250	Renewal—Group A, 2d yr.	$5,250
10.500	Additions—Groups C & D. 2d yr.	10,500
$15,750		$15,750
$18,750	Renewal and Additions—Group B, 3d yr.	$18,750
10,500	Additions—Groups A & B	10,500
$29,250		$29,250
$34,750	Renewal—Groups A & C, 4th yr.	$34,750
10,500	Additions—Groups B & C, 4th yr.	10,500
$45,250		$45,250
$58,000	Renewal—Groups A, C & D, 5th yr.	$58,000
10,500	Additions—Groups B & D	10,500
$68,500		$68,500

CAPITAL STOCK ACCOUNT.

Dr.		Cr.
	Stock Sale—Original	$105,000
$105,000	Balance	
$105,000		$105,000
	Balance, 1st yr.	$105,000
$105,000	Balance	
$105,000		$105,000
	Balance, 2d yr.	
$105,000	Balance	
$105,000		$105,000
	Balance, 3d yr.	$105,000
$105,000	Balance	
$105,000		$105,000
	Balance, 4th yr.	$105,000
	Stock Sale—Addition, 4th yr.	48,500
$153,500	Balance	
$153,500		$153,500
	Balance, 5th yr.	$153,500

CASH ACCOUNT.

Dr.		Cr.
$105,000	Proceeds—Sale of Stock	$105,000
23,551	Earnings to cover Depreciation, 1st yr.	
	Additions—Groups C & D, 1st yr.	10,500
	Balance	13,051
$128,551		$128,551
$13,051	Balance, 1st yr.	
26,594	Earnings to cover Deprec. and Int., 2d yr.	
250	Scrap Value—Group A, 2d yr.	
	Renewal—Group A, 2d yr.	$5,250
	Additions—Groups C & D, 2d yr.	10,500
	Balance	24,145
$39,895		$39,895

CASH ACCOUNT.—(*Continued*)

Dr.		Cr.
$24,145	Balance, 2d yr.	
29,558	Earnings to cover Deprec. and Int., 3d yr.	
750	Scrap Value—Group B, 3d yr.	
	Renewal and Additions—Group, 3d yr.	$18,750
	Additions—Groups A & B	10,500
	Balance	25,203
$54,453		$54,453
$25,203	Balance, 3d yr.	
35,153	Earnings to cover Deprec. and Int., 4th yr.	
1,750	Scrap Value—Groups C & A, 4th yr.	
	Renewals—Groups A & C	$34,750
	Additions—Groups B & C	10,500
	Balance	16,856
$62,106		$62,106
$16,856	Balance, 4th yr.	
37,467	Earnings to cover Deprec. and Int., 5th yr.	
3,000	Scrap Value—Groups A, C & D, 5th yr.	
48,500	Proceeds—Sale of Stock	
	Renewals—Groups A, C & D, 5th yr.	$58,000
	Additions—Groups B & D	10,500
	Balance	37,323
$105,823		$105,823
$37,323	Balance, 5th yr.	

DEPRECIATION RESERVE.

Dr.		Cr.
	Requirements, 1st yr.	$23,551
$23,551	Balance	
$23,551		$23,551
	Balance, 1st yr.	$23,551
	Requirements, 2d yr.	25,652
	Interest, 2d yr.	942
	Scrap Value, Group A	250
$5,250	Renewal, Group A	
45,145	Balance, 2d yr.	
$50,395		$50,395

DEPRECIATION RESERVE.—(*Continued*)

Dr.		Cr.
	Balance, 2d yr.	$45,145
	Requirement, 3d yr.	27,752
	Interest, 3d yr.	1,806
	Scrap Value, Group B	750
$15,750	Renewal, Group B	
59,703	Balance 3d yr.	
$75,453		$75,453
	Balance, 3d yr.	$59,703
	Requirement, 4th yr.	32,765
	Interest, 4th yr.	2,388
	Scrap Value, Groups A & C	1,750
$36,750	Renewal, Groups A & C	
59,856	Balance, 4th yr.	
$96,606		$96,606
	Balance, 4th yr.	$59,856
	Requirement, 5th yr.	35,073
	Interest, 5th yr.	2,394
	Scrap Value, Groups A, C & D	3,000
$63,000	Renewal Groups A, C & D	
37,323	Balance, 5th yr.	
$100,323		$100,323
	Balance, 5th yr.	$37,323

BALANCE SHEET—END OF FIRST YEAR.

Resources:	Dr.	Cr.
Plant Investment	$115,500	.....
Cash	13,051	.....
Liabilities:		
Capital Stock	.....	$105,000
Depreciation	.....	23,551
	$128,551	$128,551

BALANCE SHEET—END OF SECOND YEAR.

Resources:	Dr.	Cr.
Plant Investment	$126,000	.....
Cash	24,145	.....
Liabilities:		
Capital Stock	.....	$105,000
Depreciation Reserve	.....	45,145
	$150,145	$150,145

BALANCE SHEET—END OF THIRD YEAR.

Resources:	Dr.	Cr.
Plant Investment	$139,500	.....
Cash	25,203	.....
Liabilities:		
Capital Stock	.....	$105,000
Depreciation Reserve	.....	59,703
	$164,703	$164,703

BALANCE SHEET—END OF FOURTH YEAR.

Resources:	Dr.	Cr.
Plant Investment	$148,000	.....
Cash	16,856	.....
Liabilities:		
Capital Stock	.....	$105,000
Depreciation	.....	59,856
	$164,856	$164,856

BALANCE SHEET—END OF FIFTH YEAR.

Resources:		Dr.	Cr.
Group A—Property	$10,500		
Group B—Property	34,500		
Group C—Property	45,250		
Group D—Property	63,250		
Plant Investment		$153,500	.....
Cash		37,323	.....
Liabilities:			
Capital Stock		.....	$153,500
Depreciation Reserve		.....	37,323
		$190,823	$190,823

RECEIPTS FROM OPERATION.

Dr.		Cr.
	Earnings to cover Deprec., 1st yr.	$23,551
$23,551	Balance to Income Account	
$23,551		$23,551
	Earnings to cover Deprec. and Int., 2d yr.	$26,594
$26,594	Balance to Income Account	
$26,594		$26,594
	Earnings to cover Deprec. and Int., 3d year	$29,558
$29,558	Balance to Income Account	
$29,558		$29,558
	Earnings to cover Deprec. and Int., 4th yr.	$35,153
$35,153	Balance to Income Account	
$35,153		$35,153
	Earnings to cover Deprec. and Int., 5th yr.	$37,467
$37,467	Balance to Income Account	
$37,467		$37,467

INTEREST.

Dr.		Cr.
$942	Deprec. Reserve Requirement, 2d yr.	
	Balance to Income Account	$942
$942		$942
$1,806	Deprec. Reserve Requirement, 3d yr.	
	Balance to Income Account	$1,806
$1,806		$1,806
$2,388	Deprec. Reserve Requirement, 4th yr.	
	Balance to Income Account	$2,388
$2,388		$2,388
$2,394	Deprec. Reserve Requirement, 5th yr.	
	Balance to Income Account	$2,394
$2,394		$2,394

DEPRECIATION ACCOUNT.

Dr.		Cr.
$23,551	Deprec. Reserve Requirement, 1st yr.	
	Balance to Income Account	$23,551
$23,551		$23,551
$25,652	Deprec. Reserve Requirement, 2d yr.	
	Balance to Income Account	$25,652
$25,652		$25,652
$27,752	Deprec. Reserve Requirement, 3d yr.	
	Balance to Income Account	$27,752
$27,752		$27,752
$32,765	Deprec. Reserve Requirement, 4th yr.	
	Balance to Income Account	$32,765
$32,765		$32,765
$35,073	Deprec. Reserve Requirement, 5th yr.	
	Balance to Income Account	$35,073
$35,073		$35,073

INCOME ACCOUNT.

Dr.		Cr.
	Receipts from Operation, 1st yr.	$23,551
$23,551	Depreciation, 1st yr.	
$23,551		$23,551
	Receipts from Operation, 2d yr.	$26,594
$25,652	Depreciation, 2d yr.	
942	Interest 2d yr.	
$26,594		$26,594
	Receipts from Operation, 3d yr.	$29,558
$27,752	Depreciation, 3d yr.	
1,806	Interest, 3d yr.	
$29,558		$29,558

INCOME ACCOUNT.—(*Continued*)

Dr.		Cr.
	Receipts from Operation 4th yr.	$35,153
$32,765	Depreciation, 4th yr.	
2,388	Interest, 4th yr.	
$35,153		$35,153
	Receipts from Operation, 5th yr.	$37,467
$35,073	Depreciation	
2,394	Interest	
$37,467		$37,467

TABLE I.—STRAIGHT LINE METHOD.

Class	Life	Cost of reproduction new	Scrap value	Cost new less scrap	Annual per cent. of depreciation	Annual amount required to cover depreciation
A	5	$ 210	$ 0	$ 210	20.00	$ 42
B	8	7,124	14	7,110	12.50	889
C	10	17,361	153	17,208	10.00	1,721
D	12	26,272	0	26,272	8.33	2,188
E	15	143,470	11,920	131,550	6.67	8,774
F	16	65,632	33,374	32,258	6.25	2,016
G	20	113,336	9,239	104,097	5.00	5,205
H	25	43,747	7,631	36,116	4.00	1,445
I	50	14,337	0	14,337	2.00	287
J	60	1,165	0	1,165	1.67	19
K	75	21,920	0	21,920	1.33	292
		$454,574	$62,331	$392,243	.....	$22,878
		12 per cent. overhead		47,069	.....	2,745
				$439,312		$25,623

$$\frac{22,878}{392,243} = 5.83 \text{ per cent.}$$

This table shows the balance between the cost new and the scrap value to be $439,312, and the annual amount to be set aside for depreciation to be $25,623. This table also shows that the annual rate for depreciation varies from 20 per cent. for the property on the five year group to 1.33 per cent. for the property in the seventy-five year group. The average rate for all these groups is therefore 5.83 per cent on the depreciable amount.

TABLE II.—Sinking Fund Method.

Class	Life	Cost of reproduction new	Scrap value	Cost new less scrap	Annual % reserved on two per cent. basis	Annual charge to operating expenses required
A	5	$ 210	$ 0	$ 210	19.21	$ 40
B	8	7,124	14	7,110	11.65	828
C	10	17,361	153	17,208	9.13	1,571
D	12	26,272	0	26,272	7.46	1,960
E	15	143,470	11,920	131,550	5.78	7,604
F	16	65,632	33,374	32,208	5.36	1,729
G	20	113,336	9,239	104,097	4.12	4,289
H	25	43,747	7,631	36,116	3.11	1,127
I	50	14,337	0	14,337	1.18	169
J	60	1,165	0	1,165	.88	10
K	75	21,920	0	21,920	.58	127
		$454,574	$62,331	$392,243	.....	$19,454
		12 per cent.	overhead	47,069	.....	2,334
				$439,312		$21,788

$$\frac{19,454}{392,243} = 4,959 \text{ per cent.}$$

This table shows that on a 2 per cent. sinking fund basis the amount that must be annually charged to operating expenses for depreciation is $21,788 or about 4.96 per cent. of the property value.

The Chairman: Gentlemen, these papers are now open for discussion. I have a discussion of Dr. Humphreys' paper which was submitted by letter, from Dr. A. F. Weber, of New York, which I shall read.

Dr. Weber: (Written discussion communicated.) It does not seem to me advisable to engage in a controversy with Dr. Humphreys regarding a question that is now res adjudicata. Since presenting my views before the National Association of Railway Commissioners last October, the New York Court of Appeals has considered and passed upon the question in a case that originated with the Public Service Commission for the First District, and the court sustained the Commission's ruling as to deduction of depreciation, which ruling was also in accord with the decisions of the United States

Supreme Court as well as the prior decisions of the New York Courts. These prior decisions, it is true, were rendered in franchise tax cases, in which the corporations argued that depreciation was a deduction from value; but it could hardly be expected that the courts would completely reverse their decisions when the corporations assumed a directly contrary position in rate cases.

It is quite easy to attribute too much importance to some single element in rate regulation. Depreciation is only one of the many considerations that enter into the fixing of reasonable rates. If public utilities have lost ground on this point, they have gained ground on other points, because the Commissions have been endeavoring to do justice. It is well understood, for example, that the decisions of Commissions establish a higher rate of return on the investment than the minimum rates that courts have sanctioned. The result of regulation has tended towards stability of investment and consequent low rates of interest and larger surpluses for dividends wherever the capital stock has represented actual investment. An illustration of these results appears in the case of a gas company in Brooklyn which offered to put on trial any rate that the Commission might determine to be reasonable. The Commission ordered a reduction of five cents per 1,000 cu. ft. of gas, and on the reduced rate, the company is not only meeting all of its expenses, but for the first time in its history, is paying dividends. Moreover, the company by efficiency and economy is earning a surplus which it is putting back in the property in order to extinguish in a relatively short term of years, the difference between the original book value and the depreciated value at which the property was appraised by the Commission and adopted by the company on its own balance sheet as a substitute for the original book value. The investors in this company know that their investment is secure from attack, and consequently, do not expect the large speculative gains that have to be paid in one way or another by communities that have no similar policy of regulation.

Mr. C. M. Cohn (Baltimore): I have had very little time to go over Dr. Humphreys' paper. I noticed, however, that on page 1560, Dr. Humphrey points out, "Certainly, in such a case, such an estimate should not be based upon the life-tables of text-books and the like, the expected lives quoted being simply the compilation of averages covering the widest possible variations as to design, construction, etc."

My attention was called to that point because of the experience we had in Baltimore, where it was endeavored in a rate case to deduct depreciation, and to ascertain the amount entirely from so-called life-tables, without any inspection whatever of the plants. The principal witness called for the purpose of establishing depreciation in that way was asked in detail as to the various tables he consulted, and an effort was made to check up those tables. In one instance it was found that he had followed a table that had been prepared by a well-known engineering firm, and it happened that a representative of that firm was in the room, prepared to give testimony as to certain features that were being considered, and he himself, when put on the stand, explained that he had prepared the particular table that had been referred to, and that it had never been prepared by him with the idea of its being applied to any other situation than the one he was considering at the time, and he wanted to advise the Commission that the table was not at all applicable to the situation which the Commission was considering. In fact, it was explained that that table had been prepared in connection with the ascertainment of the actual depreciation of certain railway properties in Chicago, and that it had no application whatever to the situation in Baltimore.

I mention this matter to show the danger of taking promiscuous life tables and attempting to apply them to situations to which they were never intended to apply.

Generally speaking, I would like to say, that the subject of depreciation should be considered largely from a business standpoint, and while in Baltimore we endeavor to make a proper allowance for depreciation year by year, yet in the

final determination of the amount to be set aside, the operations and results of the year are considered, as they must necessarily be considered, I think, in almost any situation. We have what are known as "lean" years and "good" years, and obviously, when we have a "lean" year, as we are perhaps likely to have under the present financial and business conditions, it doesn't seem to be practicable to set aside the same amount to cover depreciation as would be thought desirable at a time when the company was enjoying greater prosperity. On the average, however, it might be considered important to have an amount of money that would fairly take care of the constantly accruing depreciation; but to lay down a hard and fast rule and say that, without regard to the consequences in other particulars, a given amount of money should be taken out of the results of any year and arbitrarily set aside to take care of depreciation, seems to me to be poor business management.

Mr. Paul Doty (St. Paul, Minn.): I think I may say that I have an understanding of some of the problems that have been presented. I think I understand that we are sellers of gas, rather than sellers of tin meters, cast iron pipes or clay retorts; and I think I have gone at times a little further in the endeavor to make clear the nature of our business, and have said that in the sale of gas we are selling a form of energy, that if we undertook the sale of gas as gas, our market would be limited to asphyxiation use; but with these translating devices, the product we sell is energy, and can be converted into light, heat and power.

I think I also understand the service problem. The homely illustrations that have been used are, of course, very clear. I have come to New York from St. Paul. I purchased from the Pennsylvania Railroad, transportation from Chicago. I did not purchase the cars, nor the engines, nor the track. The car still has the name of the Pennsylvania Railroad upon it. It was my train, when used, but it belonged to the company, so that I did not buy anything but the service.

Another illustration of this kind, not to refer again to the

hen, and the egg, and the cow and the milk, is the opinion we buy from lawyers or from experts. It is the opinion that we purchase; it makes no difference to us if it be rendered in a suit of clothes that is one year old, or in a new suit of clothes; and I may say that the lawyer, or the expert, in giving the opinion has no thought, in making his charge, of the age of the suit that he has on his back.

The problem that does confront us, as trustees of the stockholders and also servants of the public, in these rate problems, is to secure a fair return upon the fair value of the property.

Now the title of Dr. Humphreys' paper is in answer to a definite question, and those of us who have the good fortune of long association with Dr. Humphreys know that he is nothing if not exact. Suppose the question had been in this language, "In Rate-Fixing by Commissions or Courts, Should the Present Actual Depreciation be Deducted from the Reproduction New of the Physical Plant Valuation?" Those of us who have made an endeavor to present what we believe to be fair values, in our understanding of fair values, know that there are various methods of arriving at a fair value. We can show from the books the actual investment, but most of us are not in position to do that because of the age of the property. With such a condition, the reproduction new method is one way to arrive at a fair value of the property.

Now it seems to me fairly well settled (perhaps I am in error) that depreciation, present actual depreciation, can be deducted from reproduction new of the physical property in determining the fair value, but I do not want to appear in the position of answering my own question.

The question also occurs to me, "Are we flattering ourselves, and perhaps being led astray, by saying that we give 100 per cent. service?" That is, I mean, should the rates be based upon 100 per cent. physical plant value? I ask this question, and I add, "Do we give 100 per cent. service when we charge the consumer for current repairs, not the depreciation to which Mr. Erickson has so ably referred, but for current

repairs?" To make myself perhaps a little clearer in saying current repairs, I point out that it is not uncommon in gas accounting to use two divisors; one is the gas made, the other is the gas sold. The gas made and gas sold are never the same. In 100 per cent. physical plant value, with no item of unaccounted-for gas, there would be no difference between the gas sold and the gas made. But there is a possibility that we are not quite fair to the public, or not fair to ourselves, in assuming that at all times there is this 100 per cent. physical plant value.

I know there are other elements of value than physical plant value that go to make up complete fair value; these are the intangible values, going value, etc., but I do not refer to these now in a discussion of depreciation as applied to physical value.

I say that a complete understanding is a consummation devoutly to be wished. I call attention to the fact that there are forms of devotion in which this language occurs: "Deliver us from evil." Now Dr. Humphreys' paper may lead us to deliverance from evil, but the same prayer has the expression, "Lead us not into temptation," and it is with this thought I pay my tribute to Dr. Humphreys for his able presentation of the paper which is before us for understanding, and I am sure that the discussion will lead, as discussions of Dr. Humphreys' paper do, to much value to our Institute.

Mr. Richard Schaddelee (Grand Rapids, Mich.): I have not had the chance of reading Mr. Erickson's paper, so I will confine myself to Dr. Humphreys' paper. In my discussion of this valuable and timely paper I shall confine myself to answering the question propounded in the title of the paper, and shall not attempt to discuss collateral issues raised in the body of the paper. The question raised in the title of the paper is vital and fundamental to all public utility companies and investors, whether their rates are subject to regulation by Municipal, State or Governmental authorities. In analyzing this question, we must assume that the desire of the regulating

body is to fix a rate that will enable public utilities, economically, honestly and ably managed, to secure sufficient gross income to:

1st. Pay for all legitimate operating expenses, including insurance, taxes, and expenditures for maintenance and repair of property, necessary to maintain the property in first-class condition, and to render adequate and good service to the public served.

2nd. Set aside in a fund, or invest in necessary or advisable additions to, or extensions of, property, an amount sufficient to replace all property placed out of service by reason of being worn out, by having become inadequate, or by having become obsolescent.

3rd. Earn and pay a commercially fair rate of interest on the money actually invested, and sufficiently high to attract the investor, so that they will have no difficulty in financing all improvements and additions to property reasonably needed in adequate service to the public. I am convinced that in the near future the regulating bodies will add a fourth provision to the three I have enumerated, and this fourth provision will be as follows:

4th. Earn a fair and even liberal profit for the men actively responsible for, and in charge of, the management and the operation of the companies. And the commissions and other rate-making bodies will provide for this fourth clause just as soon as they realize that the people who have the money to invest in these public utilities, usually do not have the knowledge, ability or experience to construct, operate, and manage these companies, or otherwise do not care to assume the responsibility, so that, as a matter of fact, they should mete out justice and a fair reward to the man as well as to the dollar.

However, considering the present status of rate regulation by municipalities, courts and commissions, I do not feel warranted to press this fourth clause in my analysis of the question under consideration. I do affirm, however, with the

utmost deliberation, my firm conviction in the justice of it, and my equally firm belief that the commissions will soon recognize its justice.

As Dr. Humphreys so well sets out in his paper, the amount necessary to set aside to adequately provide for depreciation varies as widely as the definition of the word itself. To avoid misconception, kindly note that whenever I use the word "depreciation," I mean the cost of replacing property placed out of service by reason of being worn out, of being inadequate, or of being obsolescent.

Now, in order to solve the question at issue, it makes no difference how the money necessary for this purpose is set aside, accumulated or invested until it is needed, nor how it is treated on the books, no matter whether it is provided for in actual cash or taken care of on the books; a careful analysis will convince any one who cares to know the truth and is able to grasp it, that under no conditions, should the amount set aside out of the earnings on the books or in cash, to provide for depreciation, be deducted from the actual investment in the property, which we will assume to be the actual construction cost. And this, for the very simple reason that the setting aside of this depreciation, either as a book reserve or as a cash fund, does in no way diminish or reduce the actual investment of the investors in the property.

I can best illustrate this by an example, and in order to make it as clear as possible, we will reduce all the factors to be considered to their simplest form, by assuming a company with a brand new property, fully adequate for all demands upon it, and assume that said company has an amount of business to start with that does not vary, and that it does not have to make improvements or additions to its property. Such a company will have to replace property only on account of it being worn out, as the question of inadequacy will not be involved, and we will also eliminate the item of obsolescence as a factor. We all know that under actual conditions, the item of inadequacy is the most important and largest item covered

by "depreciation" as herein used,—much more important than the item of wear and tear, and that obsolescence is also a real important item of "depreciation."

To correctly answer the question at issue, however, it makes no difference what the component items of depreciation are nor what the correct amount is. The question is, "Whatever the amount is, should it be deducted from plant valuation, or rather from actual investment, for rate making purposes?" So if I can demonstrate a negative answer to the question by simplifying the factors, it will demonstrate the correctness of the principle in every case, no matter how complicated. The complications will be found in the determination of the correct amounts, and not in the principle that it cannot justly or fairly be deducted from valuation, for this is a principle founded on mathematics, and can therefore be analyzed and demonstrated with mathematical precision and accuracy, the ingenious arguments and illustrations of Dr. Weber and Mr. Alvord, so aptly quoted by Dr. Humphreys, to the contrary, notwithstanding.

EXAMPLE (Assumed).

Figures are not claimed to be actual or average. I am demonstrating a fundamental principle, and almost any figures will do, as no figures can change the principle.

Capital invested (valuation of property)	$250,000.00
Annual gas sales	60,000,000 cu. ft.
Average price of gas	$1.10 per M cu. ft.

We assume the company is entitled to earn 10 per cent. net on investment, after deducting operating expenses, and an adequate reserve for replacement of property. Company has an adequate and new property, and no additional investment is necessary for additions or extensions. Gas sales remain the same. $200,000.00 of its investment is in property subject to depreciation and has to be renewed once every 25 years, and it is assumed that it all wears out at the same time. (In actual practice many companies have to replace large parts of their property every 5 or 10 years, due to the growth of the city and

the growth of their business. This brings into operation the important factor of inadequacy, and also of obsolescence. These, however, affect the amount needed for depreciation, not the principle we are demonstrating.)

Salvage value of property replaced, $25,000.00 In this case it is patent that in order to replace the property at the end of the 25 years, the company will need $175,000.00 cash, and that to provide this in equal annual amounts out of earnings, it will have to set aside out of earnings $7,000.00 each year. (Assuming that the cash is deposited in the bank and draws no interest.)

STANDING OF COMPANY END OF THE FIRST YEAR.

Gross income, 60 million cu. ft. sold at $1.10	$66,000.00
Operating expenses (after deducting residuals) at 65 cents per thousand cu. ft	39,000.00
Net income	$27,000.00
Less depreciation reserve set aside in bank	7,000.00
Net earnings (8 per cent. on actual investment of 250,000)	$20,000.00
Total depreciation reserve	$ 7,000.00

At end of 10th Year.

Gross income for year, 60 million cu. ft. sold at $1.10	$66,000.00
Operating expenses for year	39,000.00
Net income for year	$27,000.00
Less depreciation reserve set aside for year	7,000.00
Net earnings (8 per cent. on actual investment) for year	$20,000.00
Total depreciation reserve in bank accumulated during 10 years	$70,000.00

At End of 25 years.

Gross income for the year	$66,000.00
Operating expense for the year	39,000.00
Net income for the year	27,000.00
Less depreciation for the year	7,000.00
Net earnings for the year (8 per cent. on $250,000.00 investment)	$20,000.00
Total depreciation reserve in bank	none

The reason there is no depreciation reserve in bank at the end of the 25th year is due to the fact that the company has had to spend the entire reserve of $175,000.00 to replace its worn out property, and it is now in exactly the same condition as at the beginning of the first year, with an actual investment of $250,000.00 earning 8 per cent. thereon.

If this company had felt reasonably sure of being able to invest its depreciation fund on a 5 per cent. compound basis, then it would have been able to figure out its depreciation reserve required annually on the sinking fund method at 5 per cent. compound interest, and this would naturally have decreased the annual amount necessary to set aside out of earnings, in order to have available the $175,000.00 needed at the end of 25 years. But this again would in no way affect or change the fact that the money investment of the investors in the company is exactly the same during each of the 25 years, no matter what the value of the property is, after deducting accrued depreciation. As a matter of fact, in actual practice, these companies need each year vastly larger amounts of new money for necessary and advisable extensions of, and additions to, property, than the amount of their annual depreciation reserve, so that in the large majority of cases, these companies simply invest their depreciation reserves in new additions and extensions, which is perfectly proper and conservative and sound business practice and principle.

If these companies kept their depreciation reserve in cash, they could earn probably only 3 or 4 per cent. on it, while they would have to pay from 5 to 8 per cent. on the new money required for extensions and additions. This would be detrimental to the public as well as to the investors.

It is true that in this case the company will have to set aside a larger amount of annual depreciation than if the depreciation was set aside in a cash fund and invested at compound interest.

This, however, is not detrimental to the interests of the public in the matter of fair rates, for on careful analysis, you

will find that the company that invests its depreciation reserve in extensions and additions, has just that much less investment to earn a fair return on. And inasmuch as a fair rate allows the company a fair return on its investment as well as a fair reserve for depreciation, it is clear that the investment of the depreciation fund in extensions and additions reduces the interest charges of the company and will more than offset the interest it would earn on the fund if set aside in a cash fund and invested at from 3 to 4 per cent.

EXAMPLE.

A company sets aside $10,000.00 for depreciation reserve each year. It also invests $10,000.00 in extensions. Now, if it invests its depreciation fund in certificates of deposit or government bonds, it earns (say) 4 per cent. or $400.00 per year. In that case it has to borrow in some way $10,000.00 for its extensions at (say) 7 per cent. or an interest charge of $700.00 per year, so it pays out in interest $300.00 per year more than it receives from interest on its depreciation fund.

If this company, however, invests its depreciation fund in its own extensions, its interest charges do not increase at all, as it will not have to borrow the $10,000.00 needed for extensions. In the first case, the depreciation reserve needed is $400.00 less than in the second case, but the interest charges are increased by $700.00 In the second case, the depreciation reserve is $400.00 more than in the first case, but the interest charges are $700.00 less, so that the company saves $300.00 by investing its depreciation fund in its own extensions, instead of investing in certificates of deposit or government bonds. And under commission or other rate regulation by public bodies, this not only benefits the company and its investors, but the public as well.

Dr. Humphreys very ably discusses the questions of the principles upon which to arrive at proper amounts of depreciation, and many other collateral and very vital issues in connection with depreciation, all of which will claim our attention very forcibly and insistently in the near future, and I am sure

that the discussion of them will clarify the vision of a good many public utility men, as well as that of the members of the different commissions.

I sincerely hope that I have been able to demonstrate to you and to the members of the commission, convincingly, the fact that "In rate-fixing by Commission, 'Depreciation' should not be deducted from Plant Valuation."

I do not have the same strong hope in regard to some of the expert authorities and courts quoted by Dr. Humphreys. At any rate, you see that I thoroughly agree with Dr. Humphreys in answering in the negative, and that emphatically, the question propounded in the title of his paper. (Applause.)

THE CHAIRMAN: Gentlemen, the subject is open for general discussion. We will be very pleased to have any man who has any views to express on this thing step forth and express them now, fully and clearly.

MR. H. W. PECK (Schenectady, N. Y.): Mr. Erickson mentioned, in connection with so-called continuous property, that the desirable way for replacement was to take it out of the depreciation reserve fund. The New York Commission requires for approval the actual unit cost of each piece of property retired. It would involve very considerable extra bookkeeping to determine the cost of each pole, of each length of pipe, of each 100 ft. of wire. They will not allow certain approximations; *e. g.,* if I should issue a job order for a month's work of setting poles, and set a pole here in sand and a pole there in rock, they make objections to grouping the month's work and taking the average figure, when it comes to replacing the pole. It seems best to put such replacements in repair account, whereby we do not have to make such careful accounting as we do if we charge it to depreciation, as we have to establish to the satisfaction of the Commission that the replacement figure is what the actual cost for that particular unit was at the time.

I am glad that Mr. Cohn brought up the matter of handling depreciation on a business basis, aside perhaps from the theory

of it. I have noticed for some time, that all of our papers on determining depreciation very properly determine it from the expected life, from one conception or another, of each particular group of apparatus. However, the very general method of actually setting aside the fund is either on a percentage of gross revenue basis or a certain amount per 1,000 cu. ft. of gas sold; in either case, a varying amount per dollar of invested capital, while the theoretical depreciation which has accrued, is a fixed amount. Mr. Cohn apparently, in Baltimore, sets aside a large enough amount in "fat" years so that in "lean" years he can set aside a less amount, from which fact I judge that he considers it more desirable to keep his dividend rate uniform and, therefore, uphold the strong financial condition of the company, than to maintain a uniform depreciation rate. That is a point on which I would like to hear the views of possibly both Dr. Humphreys and Mr. Erickson.

Mr. A. S. Miller (New York): I want to take exception to Mr. Peck's statement that it is proper to use an expected life. There is no such thing as our expectancy being realized. I particularly want to refer at this time to a large gas plant which I have valued, and on which I have assessed the depreciation, not only by going over the parts piece by piece, but by seeing each unit torn apart. I have seen the slates taken off the roof; I have seen the purlins taken down, the trusses and the bricks torn down, the cast iron broken up with a sledge; I have seen the steel cut with a burner; I have seen the bricks dug out with a pick. That piece of property, by all the life tables, should be very largely depreciated. An examination extending over a year, of each individual part, shows that an outlay of 5 per cent. of the original cost of that property would bring it up to a point where it was better than it was when new. It has been maintained in a most wonderful manner; the metal has been kept painted; parts have been replaced where necessary, the machinery has been repaired, bearings have been kept in good condition; the whole oper-

ating plant has been kept up not only to 100 per cent. of efficiency, but practically to 100 per cent. of condition.

Now how perfectly absurd it is for a lot of men who have no knowledge, or only the most superficial knowledge, of our business, to sit in an office where they have to deal with steam railroads, with electric properties, with gas, and with street railroads, and value our property on life tables, when here in practical operating condition right before their eyes, we find properties which are practically in 100 per cent. of condition, in spite of their age. No one can tell anything about a piece of property from a table, and no two pieces of apparatus, under different conditions of operation, will last the same length of time. It is most unjust, most improper, for these expectations, if you please, to be used. Of course, we have had enough experience in the gas business, extending over a series of years—for most of our companies are not new—to know about how much it will cost for maintenance and replacements during a period of years, to keep our plants in condition. We can work with figures of that kind, which may be checked from year to year by inspection, when we may see how the pieces of apparatus are being maintained and holding up, and how probable it is that it will be necessary to give up any part of the property through obsolescence. But such tables made up in all sorts of places, or made up in our own places if you please, under the management of one engineer or another engineer, or under one policy of retrenchment or another policy of putting back a large part of the earnings into the property without capitalizing them, are worth absolutely nothing. They are not only worth nothing, but are so misleading, and their use is so unfair, and has cost the companies of this country so much, that we cannot be too emphatic in condemning any such practice.

I am very sorry that Dr. Weber is not here, because there is a statement made in his letter answering Dr. Humphreys, which is true in itself, but very misleading, taken as it is made Dr. Weber, instead of answering Dr. Humphreys' paper,

belittles it. He says, "It is quite easy to attribute too much importance to some single element in rate regulation," with which I quite agree. "Depreciation is only one of the many considerations which enter into the fixing of reasonable rates. If public utilities have lost ground on this point, they have gained ground on other points because the commissions have been endeavoring to do justice. It is well understood, for example, that the decisions of commissions establish a higher rate of return on the investment than the minimum rates that courts have sanctioned." He is praising the commissions because they have admitted a rate barely above what the courts have declared confiscatory. Why that has helped any property in this country, I wish Dr. Weber would explain.

"The result of regulation has tended towards stability of investment." Well, no doubt it has, and if you will knock off about 50 per cent. from the upper part of any building, the rest of it will be more stable than it was in the form of a perfect building. That is the way the investments in many cases have been rendered more stable. All the upper part has been knocked off. Naturally, the foundations are more stable than the superstructure, and in many cases, we are getting down to the foundation. Of course, if we would fire a shell into one of these buildings and knock off the upper part, we could say "It is more stable," and we might congratulate ourselves that it is more stable, but I don't think we would congratulate ourselves that we had done a good deed, because we had rendered it more stable by knocking off the upper half.

"An illustration of these results appears in the case of a gas company in Brooklyn which offered to put on trial any rate that the commission might determine to be reasonable. The commission ordered a reduction of 5 cents per 1,000 cu. ft. of gas, and on the reduced rate the company is not only meeting all of its expenses, but for the first time in its history is paying dividends." Now the history of that case is an open one; it has been published by the commission. In the first place, there is no evidence whatever in the history of the case,

and there is no evidence obtainable from any other source, that anything that the commission did, has accomplished anything for the benefit of the company. In that particular case the commission, after valuing the property at a greatly reduced value, and after telling the company that they were entitled to 7½ or 8 per cent. earnings, established a rate for gas under which the company could not possibly earn 7 per cent. It was a very fair statement as the whole thing was set off, but when they came to the earnings, they were not there. Now the commission has knocked off some of the upper stories and the property is more stable, we must admit that, but it has not helped the property as a whole.

"Moreover, the company by efficiency and economy is earning a surplus which it is putting back in the property in order to extinguish in a relatively short term of years the difference between the original book value and the depreciated value at which the property was appraised by the commission (it was appraised at a depreciated value, there is no question of that) and adopted by the company on its own balance sheet as a substitute for the original book value." Now, that company had been writing off for many years previous, what they felt was an inflated value, as shown by the books. The company did not change its methods as the result of any commission report. They simply followed along; the commission stabbed the company cruelly, and then said, "Keep on doing what you have been doing," and now it takes credit for having ordered them to do what they were doing before. (Applause.)

Mr. R. A. Carter (New York): Mr. Chairman, my remarks will be directed more particularly to Mr. Erickson's paper, though they will cover some of the points presented by Dr. Humphreys. I feel it is important that the attention of the members of this association present here, should be drawn to this fact, that Mr. Erickson's paper deals with problems presented by a theory of depreciation in accordance with which from 20 to 40 per cent. of the investment in utilities of this country may be confiscated. Just measure what that means,

because the investments in utilities in this country run into billions of dollars. Twenty per cent. of the value of the property of utilities would represent several billions of dollars. Mr. Erickson's paper recommends a theory of accounting, the adoption of which would commit utilities to the acceptance of this theory, and I want to warn the members of this Association against the acceptance of any system of accounting that threatens the impairment of the investment of their stockholders, of which in a measure they are trustees and custodians.

I believe, Mr. Chairman, that the problems presented by this paper are less engineering and accounting problems than they are financial and economic problems. It is fortunate that these are problems, because in the course of the discussion of those problems, the people principally interested, namely the investors and the public, are going to have their minds enlightened on this important subject.

When I hear the word "obsolescence" mentioned, I look forward to the time when the term "depreciation," in so far as its use in connection with the properties and accounts of public utilities is concerned, will, in its turn, become as obsolete as any piece of junk that ever decorated a scrap heap. I believe that the time is coming, and is coming soon. The term and its misuse have already survived too long.

I wonder, when I hear people discussing theories of reserves for depreciation, whether they realize that the courts are construing these claims on the part of the companies for reserves for depreciation to be admissions on the part of the companies, that their properties have depreciated? The Master in a California case very recently said in his opinion that it was not consistent for companies to set up a claim for substantial reserve fund for depreciation, and at the same time, claim that their properties were not depreciated.

My observation leads me to believe that the advent of the depreciation theories which are now being so widely debated, was contemporaneous with the advent of the regulation of

the rates of public utilities. I will undertake to say that the subject received little if any consideration prior to 10 years ago. At the outset, the theory of depreciation was presented in its crudest possible form. When applied by an alleged expert to the property of a utility whose rates were under review, it amounted to little but this: This plant when new had a life expectancy of 45 years; it is now 15 years old, 33⅓ per cent. of its value has depreciated, vanished. Its present value, therefore, is 66⅔ per cent. of its reproduction cost, and on that valuation only is the utility entitled to earn a return. And there the theory ended. But it was so raw and so crude that the courts would not stand for it. Something was required to make it more palatable. The so-called reserve for depreciation theory was then exploited, and it was argued that a reserve equal to the amount of the alleged accrued depreciation should have been accumulated by the utility, and that failure to accumulate such a reserve was conclusive evidence that the property had been milked, that excessive dividends amounting to a return of a part of their investment had been paid to the shareholders, and that a deduction of the alleged accrued depreciation from the reproduction value of the utility's property left it all that it was entitled to earn a return upon.

Naturally, such a theory could not be presented unless there were coupled with it a theory of providing, out of present and future earnings, that kind of a reserve fund, or the kind of a reserve fund, rather, which it was alleged should have been accumulated in the past; and as a result, the accounting orders of the commissions in many states prescribe that depreciation funds shall be created. But it is one thing to prescribe the accumulation of depreciation funds, and quite another thing to enforce them by law. The fact that such orders are in a great measure ignored, without any attempt being made to enforce them, is significant. The fact that no two writers on the subject of depreciation, who are exponents of the theory, agree, is also significant. The only evidence of agreement is

found in the treatment of the subject by some of the most eminent economists in this country, who contend that there should be no deduction of so-called accrued depreciation in order to find the present value of utilities, property, and that a reserve for depreciation is unnecessary. They take issue squarely with the proposition contained in a paragraph appearing on page 1585 of Mr. Erickson's paper, which is as follows:

"Larger plants, such as railways, are often in position to so adjust their renewals that the cost of the same remain fairly constant from year to year."

That is not confined to railroads; that is the case with electric properties, gas properties, telephone and all other kinds of utilities. Mr. Erickson says:

"In such cases it may not be necessary to provide for depreciation in advance, since the cost of the renewals can then be charged directly to the operating expenses."

That is true of all the others, but mark this:

"Under this practice, however, there is often a great deal of accrued depreciation that is not offset by assets in other forms. Without reserves of some sort, the investment cannot be kept intact."

Here is what Prof. Allyn A. Young, of the Department of Economics and Finance of Cornell University, says in that regard:

"In other words, if a company in a condition of normal operating efficiency is permitted to earn only on a 'depreciated' investment, this can only be because the company has earned larger profits in the past than it would have earned if it had been forced to put part of its gross earnings into an absolutely useless depreciation fund. It cannot be maintained that the company could ever have expected to make this disposition of its gross earnings; it cannot be maintained that it should have done so, or even that any one could have expected it to do so. Who can say that the investment would ever have been made if an idle depreciation fund (or its

equivalent) had been insisted on? To insist on the deduction of 'depreciation' from the total 'valuation' of a large public service company is to pass by the obvious and simple facts of the case and to be misled by a bookkeeping fiction."

He says again, in another paper:

"In many cases, capital would never have been invested in particular undertakings, if it had been imagined that the earnings of the capital would be burdened not only with the admittedly proper duty of maintaining and replacing the capital assets as they actually wear out, but with the further and useless load (certainly never anticipated) of maintaining a perpetually idle 'reserve for accrued depreciation.' And if it is unjust to expect that a 'reserve for accrued depreciation' should, in addition to all proper replacements, have been required from a company from its beginnings, it is equally unjust to deduct 'depreciation' from the value on which a public service company should be allowed to earn, for the two requirements are, in essential principle, identical."

Prof. J. Lawrence Laughlin, of the Department of Economics of the Chicago University, in the body of his paper writes as follows:

"The case may be illustrated by the water in a mill-race which pours upon and turns a mill-wheel. As fast as water from the stream runs over the wheel, it is replaced by new water, so long as the stream retains its original volume. That is, to secure continuity and efficiency of power, the waste in the stream is constantly made up. So long as the stream is supplied at its source, it continues its existence indefinitely. If the supply to the mill-race is cut off, the power is directly diminished. Likewise, if the loss and depreciation to an investment is made up as fast as it depreciates, only the original stream of capital is maintained. If the loss is not made up, the original stream of capital has been reduced to the punishment of the investor. In short, maintenance is the right of the investor. But, if so, there is no justification whatever for subtracting anything from the amount of the original invest-

ment, because of a supposed depreciation during the years the plant has been in use. If a bolt, a switch, a motor, an engine, has been necessarily replaced as soon as that part has become unfit for efficient service, *the system as a whole remains intact in its value;* and of course, the whole value should receive its own annual dividend. If maintenance is admitted, it seems to me there cannot be two opinions as to the injustice in subtracting a supposed depreciation, which admittedly does not exist from the total valuation, to earn dividends."

Prof. Gephart, of the Department of Economics of Washington University, in concluding his paper, says among other things: "Under these depreciation reserve theories, the public is forced to pay an unnecessary charge for the service into an unusable fund, if a depreciation fund is accumulated."

"Fourth, in valuing such a plant, no deductions from capital need be made for depreciation. Public regulation should compel the plant to be maintained in a manner to serve the public efficiently and this compels the replacement of parts continually."

"The utility plant is not a machine with a certain life term of service. Therefore, in determining the amount of capital upon which the investor should be permitted to earn, no deduction should, in the assumed case, be made for depreciation."

Professor Lewis H. Haney, of the Department of Economics of the University of Texas, says:

"(2) For another thing, it has been made clear that the plant, as a whole, can never, even theoretically, depreciate to zero. Its life, so long as it gives service, is everlasting. That being the case, its 'theoretical present value' based on remainder of life can have little significance. As stated before, such a valuation is purely a phase of theoretical accounting. *A well maintained plant composed of many units, where proper replacements are promptly made, does not depreciate in fact, and its lessening of value is only theoretical.* The idea has crept in that theoretical depreciation may be deducted from the true investment, and that the owners can and will

continue to furnish their capital to the public service. This should now be recognized as an economic error and thoroughly unjust and inexpedient."

It is very comforting to find that profound thinkers are declaring themselves emphatically and vigorously along sound lines on this subject. We hear enough along the other side, Heaven knows.

It has been shown by Mr. James A. Allison, in his report to the St. Louis Commission, under date September 11, 1912, that in an extensive public utility system progressively built, which has arrived at its maturity, there will be a fairly equal average annual expense of repairs and replacements, and that a charge in the rates for such repairs and replacements in any year will be sufficient to pay the expense of ordinary repairs and replacements of that year. If, therefore, a public utility receives in its rates an amount necessary for replacements that year, it receives from the public an amount equal to the loss caused by retirements in that year; that is to say, an amount equal to the value new of every plant unit displaced in that year. In other words, when a plant unit is abandoned under such circumstances, it may be said to produce, or earn, or yield to its owner an amount equal to its cost; and it follows that the owner's expectation of receiving such amount when a plant unit shall be retired, and his right to charge and receive it, confer upon the plant unit, considered as a part of the entire system, and not as an object to be separately sold, a value equal to its value new.

Of course, if a plant unit continues to have a value equal to its cost of reproduction, until it is displaced, it does not depreciate. There can be no such thing as depreciation of such plant unit, it being remembered always that depreciation means lessening of value, and not deterioration.

When investors in utilities and the public (I have mentioned that they are the people practically interested) come to understand each other, as they must in time, I am sure they will have no trouble reaching an agreement to the effect that in

order to keep an investment intact, investors shall not be obliged to exact, nor the public be obliged to pay, higher rates than are necessary to cover operating expenses, maintenance of the property, and yield a fair return on such investment. The public will never stand for any purely theoretical diminution or impairment of investment to be made good to the investors out of the public pocket. Even though, under this guise, Municipal or Federal ownership might be accelerated, or future (not present) patrons of the utility receive service at a lower rate, it will be found that the public is no more anxious to return to investors a part of their investment in the rates they pay, than investors are to collect part of their investment in such rates, and I am perfectly satisfied that no one is going to contend for a moment for a return of their investment in the rates.

On the subject of the collection of replacement allowances in advance of replacements, that such a fund is unnecessary for renewals has been sufficiently shown by Mr. Allison, in his report previously referred to. One of his conclusions, formulated as "Theorem Three," is as follows:

> "In a property where items of similar life have been installed at different periods, there can never be a need for all of the fund, which has been accumulated from Theoretical Depreciation charges made from the installation of the property, *i. e.*, a part of the fund will be useless, so far as renewals are concerned."

And if useless why collect it? And especially why collect it if it is to be deducted from the value of the property in rate regulation? He demonstrates mathematically that a street railway company which should accumulate depreciation allowances in a fund, from the very beginning of its operations, drawing on the fund for replacements whenever necessary, would reach a condition, after a complete cycle of replacements, when its fund would amount to 42.75 per cent. of the original cost of its property, and that, thereafter, this amount would never be decreased, because subsequent allowances,

computed by the Straight Line method, would suffice to pay for all replacements.

Practically the same conclusion had been reached by Mr. Grunsky, in his paper which appeared in *Transactions of the Am. Soc. of C. E.*, Vol. LXXV, p. 770 (June, 1912). Making his computations by the Sinking Fund method, he showed that it would result in a fund approximately equal to 40 per cent. of the cost of the plant, which fund would never be drawn on for replacements, and that its only use would be to earn interest which, added to allowances computed by the Sinking Fund method, would be sufficient to pay for all replacements made after the maturity of that fund (pp. 779, 785).

And in March, 1910, the Wisconsin Commission, after examination of a gas plant, which it appraised at $412,000, and an electric plant which it appraised at $535,000, and after estimating terms of life of various pieces of apparatus by periods during which like apparatus had been in service, concluded that if depreciation allowances had been accumulated through two complete cycles of replacement, there would be an average balance in the replacement fund (that means a perpetual average balance in the replacement fund) of the gas plant of $139,397, and in that of the electric plant of $173,887, substantially over 30 per cent. of the investment in the property.*

Mr. Allison's conclusion that a reserve fund, accumulated from the beginning of operations, will be wholly unnecessary for the purpose of replacements, in the case of a large, mature system, has been adopted by Prof. Allyn A. Young, who says:

"The fallacy in the view that the 'reserve for accrued depreciation' is a necessary record of fact, hinges on what is from the economic point of view the more or less accidental circumstance that the productive equipment of an undertaking happens to be in units of a sort that are defined as units by the customary categories of purchase and sale. In economic fact, the property of a public service undertaking as a whole

* State Journal Printing Co. vs. Madison Gas & Electric Co., 4 W. R. C. R., 501, 611.

is a productive unit. Consider it as such,—then replacements appear merely as repairs necessary to keep the whole property in a state of efficiency. Repairs in this large sense are of course to be counted as operating expenses, as is true of minor repairs. But if such repairs are fairly regular in amount year by year *there appears to be no inexorable reason why a fund to provide for them should be accumulated in advance, and more especially a fund that will amount to much more than the actual annual cost of the repairs."**

On the subject of division between repairs and maintenance, a replacement of an insulator, on a cross-arm of a telegraph pole, is a repair to the cross-arm; replacement of a cross-arm is a repair of the pole; replacement of a pole is a repair of the line; replacement of a line is a repair of the system. Any line drawn between repairs and replacement is purely arbitrary. It does not necessitate different treatment.

As to the method of accounting, accounts should record facts, but prevailing accounting rules, prescribed by commissions, exploit unsound theories of "depreciation" and "present value," and direct utilities to make entries which are misstatements, in so far as they prescribe the entry of arbitrary debits to operating expenses and corresponding credits to a "Depreciation Reserve." Such entries purport to show the incurrence by the utility of actual expenses, whereas what they really show is theoretical and fictitious expenses, based upon plausible but fallacious theories of so-called depreciation.

Such rules defeat the intent and purpose of commission regulation, which are to secure to the public adequate and proper service at minimum cost, because they compel utilities to include amounts in each year's operating, expenses which are not cost, and such amounts must be included in the rates.

All the above objections will be obviated if commissions shall prescribe that utilities shall set aside monthly, out of their earnings, such amounts as will be required for maintenance of plant and equipment, including repairs and renewals;

* "Depreciation and Rate Control," *Quarterly Journal of Economics*, August, 1914, (pp. 630, 650).

that the amounts to be so set aside shall be determined by each utility upon the basis of its own experience, that is to say, upon the basis of the average actual annual cost of maintenance of its property during a period of years; and that against the fund thus created, there shall be charged actual expenditures for repairs and actual value of property withdrawn from service.

It should be further prescribed that independently of their accounting transactions, utilities shall report to commissions having supervision, all plant and property withdrawn from service, and that the value of all plant and equipment withdrawn from service shall be charged against the maintenance fund, unless permission is obtained from the commission, in case of withdrawal from service of an extraordinarily large unit, to distribute such charge over a period of years.

Such accounting practice would meet all the requirements of a proper and reasonable regulation of public utilities, in respect to their accounting. It would not prevent distribution of cost of maintenance over as many operating accounts, or subdivisions of operating accounts, as may be deemed essential, either for information of commissions or for purposes of utilities, in the administration of their business. The method proposed will record facts and not predictions. No commission which adopts it will be under the necessity of reversing itself, as the Interstate Commerce Commission has done a number of times; nor will any commission which adopts it be in the position in which other commissions have been placed, of finding that their rules are ineffectual, because utilities ignore them, and they are not legally enforceable. (Applause.)

MR. COHN: May I be permitted to say just one word before the discussion is closed? In Dr. Weber's paper he refers to the doctrine of *res adjudicata*.

My understanding of the doctrine of *res adjudicata* is that it applies only to any particular proceeding as between the same parties, and a final adjudication of the questions in that particular proceeding between those parties closes the case as far

as they are concerned. I do not think, however, that the doctrine has ever been applied quite as broadly as Dr. Weber would suggest that it be applied in this particular situation.

THE CHAIRMAN: The time for discussion is about up.

MR. ERICKSON: I do not want to discuss Mr. Carter's paper and remarks; I simply want to say this, I think he wholly misunderstands the system of accounts which was outlined in that paper. That system of accounts is entirely designed, or expressly designed, to keep the investment intact, and the provisions there made are only sufficient to keep it intact, so that the value may be used for rate-making purposes, and that the maintenance of the value new is maintained by the consumer instead of by the investor.

THE CHAIRMAN: There is a very simple point in connection with the matter of depreciation which sometimes seems to me important, and as it has not been brought out I think I will mention it, and will try to do so briefly.

Judging from the various profound discussions of depreciation, it is apparent that gas companies, in their development, have been accused of error in supposing that depreciation would be analogous to the saving that an individual makes as a provision against old age. One doesn't begin to save for his old age when he is in the cradle; neither does he waste his early capital by putting that aside into a fund for old age. Property, like an individual, has its period of growth, use, decay and death, and the proposal that any property should begin any reservation of funds or any withdrawal of capital necessary for its activity, before that company has established its business, is a preposterous assumption to make as a matter of business.

I agree perfectly with Dr. Humphreys in what he says and indicates as to the use of this word "depreciation." Technically and strictly, there is no such thing; it is renewals, replacements, maintenance, obsolescence, inadequacy, contingencies and all of these things. But there are many very solid bankers who think they have a very clear idea of what "de-

preciation" means, and there are a great many good bond buyers who demand the use of the word "depreciation." Therefore, it does not rest with us to correct their use of words, for that is largely what it amounts to.

But here is the point I want to make: With respect to gas companies, most of them had not made the repairs, the renewals, the replacements, the foundation of the funds necessary to care for inadequacy and obsolescence when the commissions valued their property, and began to talk about rates based upon this value. In other words, they had rates not sufficient to take care of what they would claim to be the accruing expenses of conducting the gas business. Now, this being the case, haven't they the right to demand that those items should be taken into consideration in fixing rates for the future, without raising the question as to whether large deductions from the value of their property should be made? There really is no connection between them. Rates must be made under the law of supply and demand. A rate has got to be such a rate as will gain and hold customers; it has not got to be such a rate as any commission theoretically determines as a result of a mathematical computation that we cannot understand and grow dizzy listening to. If they would give us rates based upon those things we could not sell our gas during the period of development. We must put our rates lower than we can afford to put them, as we develop our business; and we have done it. The gas business ought to have credit for this; it ought to have recognition. Public officials who control us ought to realize that we have sold our gas too low. Why? Because we knew we had to sell it too low in order to get the volume of business that we must have in the end, to provide for all of these things. And I believe—I do not know, but I believe that we are a little misunderstood, because judged by our actions we have assumed that the time to provide for old age was during the period of our earning activity.

Dr. Humphreys: (Written rejoinder communicated.) In the opening paragraph of my paper I draw attention to the "mis-

understandings resulting in failure to agree on fundamentals," and I refer particularly to the misunderstandings which have been in evidence during the late years in connection with papers and discussions on "depreciation" and valuation of public service properties. This warning evidently was of little effect for much of the discussion of the papers before us certainly shows a lack of complete understanding of the question my paper was intended to answer.

On such occasions, my first inclination is to regret that I have written the paper so misunderstood. My second thought is that we all should be willing to persist in the effort to develop the truth for the very reason that this can be done only by continuing these discussions with open minds to the end.

The remarks of some of those who have discussed these two papers illustrate the point I have so often made, namely, that many of us disagree from each other on questions at issue because we are talking at cross purposes. In the hope, then, that I may be able to eliminate some, at least, of the misunderstandings again in evidence, I shall venture to consider in some detail the points brought out in this discussion, and in so doing, shall not hesitate to repeat myself.

Mr. Cohn gives a striking example from his own experience of the misuse of life-tables. Those of us who have had experience in cases before Public Service Commissions and Courts have also had the experience not only of the misapplication of tables avowedly prepared from averages, but also of tables prepared for a specific case and so carefully labeled; these last being used without modification in some other case possessing very different characteristics. Such was the example given by Mr. Cohn. Prof. Bemis' repeated use of my Holyoke table, prepared for that particular case, the conditions being most extraordinary, and repeatedly shown so to be during my evidence, is as flagrant a case as has ever come under my notice. In saying that this misuse of the table by Prof. Bemis was repeated, I wish to make it clear that the fault was repeated after his error had been time and again pointed

out to him by reference to specific statements made many times in the course of my evidence to the effect that these estimates of life were made only for the purpose of arriving at a basis for the separate and combined cost of repairs and renewals, the accounts being unusually deficient as to classification. It is noteworthy that this Holyoke table includes no claim for some of the parts of plant having the shortest life, for the reason, as explained, that the cost of renewals was to be found in the current cost expenditures. I also stated why my table could not be used in valuing the plant.

It is also noteworthy that this distinction so carefully made and explained in my evidence, appears in a case dating back to 1902. This shows that in advocating the desirability of setting up a reserve for deferred renewals, I have always eliminated from consideration those items which were covered by current expenditures. Also my practice contemplates charging against the reserve account *all expenditures for renewals of parts included in the estimate, and only those parts.*

This also means that after the total yearly expenditures for renewals run from year to year with a fair degree of uniformity and under the conditions found, a liability was not building up for the renewal of parts of long life, no *further* reserve would be required for "depreciation." Such a condition may be found to be more or less closely approximated in certain large properties built in units at different times; but this is not a general condition found in the case of single gas, water, or electric plants.

Strictly speaking, no complete cycle can be found in any plant which is growing, taking the plant as a whole; and even if we assume a plant which has ceased to grow, at the end of a so-called cycle, there would almost certainly be found a liability still to exist for deferred renewals, for the reason that all of the several periods of life would not end on the same date; namely, the date of renewal for the part of longest life.

In the New York Consolidated Gas Case, Judge Hough disallowed a reserve for deferred renewals on the ground that

the amount per 1,000 cu. ft. which he allowed for all maintenance charges was the average which had been so expended during the past 20 years. To support this reasoning it would have to be assumed that the longest life of any part of the plant was 20 years; an absurd assumption. Furthermore, it would have to be assumed *that 20 was a multiple of all the other lives or cycles involved.*

I certainly do not wish to have it understood that even in such cases of assumed practical uniformity of annual expenditures for up-keep, a reserve, strictly limited, should not be allowed for extraordinary expenditures. I enlarge later upon this feature of limited permanent reserve.

Replying to Mr. Doty, my proposition is not intended to cover the actual depreciation in a poorly maintained plant. I distinctly stated in my paper that I was referring in the use or misuse of the term "depreciation" to the *"accrued liability for the deferred or periodic renewals* of plant." I here assume, and always assume in discussing this question, that the plant is adequately maintained for complete, efficient, and economical service. Current repairs should be charged for in the rates, for the expenditures for repairs are required to enable us to give the 100 per cent. service to which Mr. Doty refers. The same can be said of the expenditures for all renewals and replacements. Finally they are all in the one class and might be included in a single term such as maintenance or upkeep. Mr. Doty's reference to two divisors as used in calculating the cost per thousand of gas, does not in any way enter into the question under discussion. The total cost per thousand is found by dividing the total operating expenditures by the total thousand feet of gas sold. When we come to analyze our cost, we find the cost of manufacture by using the amount manufactured as the divisor. As Mr. Doty very well knows, when we add this cost and the leakage cost, and the costs of distribution, administration, etc., together, we get the same final result as we get by using the gas sold as our divisor.

Mr. Doty expresses some fear if I understand him correctly, that in trying to "deliver from evil" I am forgetting the associated petition "Lead us not into temptation." In reply let me say that I am not claiming 100 per cent. efficiency for a plant which is run-down, obsolete, inadequate, and so, inefficient and uneconomical. I do not consider such a case because there should be no such case. To Mr. Doty and any others who may fear that I may be leading them into temptation by not keeping fully in mind the rights of our customers, let me suggest that they keep their plants in condition to render service up to "100 per cent. efficiency," and then they need have no compunctions for charging the cost of this upkeep, with all other items of cost, to the consumer, provided all of the upkeep cost so charged, goes into the plant and not into dividend checks. I might also suggest to those of hypersensitive moral sense, that a plant which has been in operation for many years, if honestly and competently maintained, may well be capable of rendering 100 per cent. efficiency, where the new plant might and probably would fail to do so. Where it not so, there would be no basis for increased value of a plant which has outlived its infantile diseases.

Mr. Schaddelee shows that he understands the conditions under which I claim that so-called depreciation should not be deducted from valuations. He, therefore, also assumes that the public utilities are to be "economically, honestly and ably managed." I presume Mr. Schaddelee in referring to his fourth item of profit which he hopes and believes will be in time allowed by the regulating body, has in mind a profit over and above a fair return to the preferred investor to compensate those who manage the business and so guarantee the income to the preferred investor. There are a number of ways in which this could be accomplished—but that is another question. I certainly believe that the return should not be held down to a strictly limited rate on the actual investment, called "fair" because it is not absolutely confiscatory.

Mr. Peck refers to the desirability of keeping the dividend

rate uniform, and he asks me to discuss this proposition. This is what a "depreciation" reserve provides for in part. I suggest, as I have done frequently in the past, that our public service corporations should not only be permitted, but be encouraged, to establish *limited* and reasonable reserves to compensate for fluctuations in operating expense and income. Here we have as an example English practice which, in the main, has proved satisfactory. The older practice, which is still in force, is to allow the companies to establish a reserve from income, the reserve not to be allowed to accumulate beyond 10 per cent. of the capital. This is to cover two classes of demands—first, extraordinary contingencies such as fires, explosions, strikes, etc., the withdrawals to be made only by the concurrent order of two justices; second, the more ordinary fluctuations in net income. Withdrawals from this reserve for any reason are to be charged against the reserve, and then additions thereto to be allowed until the 10 per cent. limit is again reached.

Under the general provisions of the sliding-scale acts, an insurance reserve allowance of 1 per cent. a year is authorized to cover extraordinary contingencies such as fires, explosions, strikes, etc.; not to accumulate beyond 5 per cent. of the capital, and withdrawals to be made only by concurrent order of two justices. Also, there is allowed the building up of a reserve against ordinary fluctuations in net income. The annual contributions to this second reserve are not limited nor is the total accumulation limited, and this for the reason, unlike the insurance reserve, that the contributions thereto are taken from the profits permitted to be distributed within the maximum or standard dividend rate.

Here we find, while the details vary, that the setting up of a *limited* and reasonable reserve is approved, and so provision is made for the prevention of unnecessary fluctuations in the rates of return on investment.

It will also be seen that these reserves do away with the need of a separate "depreciation" or renewal reserve.

It should be evident that this common-sense practice as to

general reserve operates to the advantage of the rate-payer as well as to the advantage of the public utilities, for the reason that the consequent steadying of dividend rates tends toward cheaper rates for money for extensions and for new enterprises of a like character.

Even the Public Service Commission law of New York State authorizes "a reasonable average return upon capital actually expended and to the *necessity* of making *reservations* out of income for *surplus* and contingencies." See Section 72 of the Statute.

We are not infrequently inclined to wonder if the members of the two New York Commissions have failed to notice this part of the statute.

Notwithstanding that by so doing, I am in some measure repeating myself, I wish to endorse emphatically Mr. Miller's condemnation of the practice, all too common, of placing reliance for specific application on expectation-of-life tables, based upon averages. Particularly I object to this absurd practice, because it encourages non-practical theorists to make valuations, or express opinions thereon which have no regard for the local and other special conditions involved in the particular case under consideration. I also agree with Mr. Miller in his criticism of Dr. Weber's written discussion of my paper. Even if the claim could be verified that the commission referred to had helped in certain particulars the companies under its control, this would not afford a defense against the charge that they had been unjust or tyrannical in some other particular. But the fact is that Dr. Weber fails to specify in what particular the companies have so been helped.

It should also be noted that Dr. Weber fails to recognize the difference between a fair rate of return and such a rate as would not be actually confiscatory. This is a distinction which is conveniently left out of the reckoning by many of the economists and others who tell us that property owners are finally protected in their investments by the U. S. Supreme Court.

With regard to the illustration furnished by Dr. Weber of

the beneficent effect of his commission's regulatory efforts "in the case of a gas company in Brooklyn," the fact is that Dr. Weber's statement is most misleading. The company, unwisely as it now appears, placed itself in the hands of the commission, hoping to receive fair treatment. The commission deducted large amounts for "depreciation" based on life tables, and also made an insufficient allowance for the actual expenses of operation. The dividends referred to as a result of the commission's beneficent work do not represent increased earnings, as the company had been making the earnings before and putting them into plant extensions to offset previous possible over-capitalization. My criticism of Dr. Weber and of the commission's action is spoken advisedly.

I confess that I fail to find in Mr. Erickson's paper an effort to confiscate investment. I cannot help feeling that Mr. Carter has misread Mr. Erickson's paper. If Mr. Erickson does believe in deducting for "depreciation," or reserve for renewals, he does not, as far as I can see, disclose such a belief in his present paper.

Referring to Mr. Carter's remarks in general, my contention is that in setting up a reserve for the purpose of spreading the cost of periodic and final renewals or replacements over the working life of each part of plant, we are only making an accounting provision against an over-statement or under-statement of each year's divisible profits, so providing against bad financial practice and placing the burden upon the consumers who get the present benefit. And the purpose thus defined, should furnish no excuse whatever for deducting the balance to the credit of this reserve, from the cost new of the property involved.

I presume Mr. Carter shares with others the belief that if such a reserve is set up, the commissions, under the influence of so-called experts within and without their organization, will take advantage of this reserve on the company's ledger to claim that the company has acknowledged that its plant is depreciated in the amount so indicated. For one, I do not pro-

pose through motives of policy (mistaken policy, as I believe) to accept as final, such ruling, a ruling which I firmly believe will in the end be declared to be confiscatory. If we give way to that which we believe to be wrong in the decisions of commissions and courts, then there remains no hope for the ultimate protection of the honest investor.

It is to be borne in mind, as I have pointed out in meeting Mr. Doty's remarks, that I am always referring to necessarily deferred expenditures for periodic or final renewals or replacements when I speak of "depreciation." I use the term "depreciation" because it has come into general use and so we cannot safely ignore its use or misuse. Also, it is to be borne in mind that I always assume that the plant is kept up to full efficiency by current repairs, renewals, and replacements. It seems to be necessary to reiterate this statement. Also, that the "Depreciation" Reserve should have charged against it, all expenditures for renewals and replacements of the parts included in the original reserve estimate, and that at any time the credit balance, with its prospective accumulations represents only such an amount as we honestly believe will be later required to meet the deferred renewals and replacements, with a reasonable allowance for error in estimating; and in this connection, that we should constantly be alert to check up our estimates so that the balance to the credit of reserve shall not materially exceed what we believe will be finally required for the deferred renewals. Then we have to bear in mind extraordinary contingencies outside of renewals and replacements, and for this purpose a separate *limited* reserve should be allowed, this in time to be debited as contingencies have to be met by expenditures, and then the reserve to be allowed again to accumulate up to the maximum limit and no further, all as suggested in connection with my reference to English practice.

Again, I do not agree with Mr. Carter that the term "obsolescence" should not be used. A plant does become obsolete; then why not acknowledge the fact and make a rational effort

to provide against too great a financial burden falling upon any one year from this cause? This factor of obsolescence must be considered in estimating the cost of future renewals, but it is a factor most difficult to appraise. The electric companies, particularly in the early years of the industry, had to meet obsolescence, and to such an extent that it was impossible to pay for all the obsolescence from current or even future income. If they had been obliged to do so, they would have had to charge such high rates for their service that the growth of their business would have been retarded if not entirely halted.

I am fully aware of the tendency of the courts to order deductions for "depreciation"; it is our duty to go on trying to educate the commissions and courts *to recognize the difference between real depreciation and reserves for renewals or replacements of plant required for the continuous service rendered to the public.*

Mr. Carter is wrong, as far as I am personally concerned, in thinking that "the advent of the depreciation theories . . . was contemporaneous with the advent of the regulation of the rates of public utilities." My theories, as I now endeavor to explain them, I have held and acted on for many years. My first journal entry to reduce the apparent profit of the year and so provide a reserve for the renewal of certain parts of the first gas plant I had charge of, was made a little over 40 years ago. I have already referred to my testimony in the Holyoke case given 12 years ago.

As it seems to me, Mr. Carter, in his discussion, has in mind only the larger corporations, whose properties consist of many units built at widely different times. Here it may well happen that the periodic and final renewals or replacements may be so made, that year by year the total expenditures therefor will be sufficiently uniform to obviate the actual necessity for a continuing reserve. If no liability is being built up against the property, there is no need of any additional contributions to the reserve.

In my writings on this subject of "depreciation," I have frequently used this point to illustrate the necessity for a reserve where no such averaging of annual expenditures can be found. Those who have had experience with plants consisting of a single unit can best appreciate that where the annual expenditures for periodic and final renewals or replacements are not approximately uniform, a reliable statement of the annual profits cannot be made unless the year's liability for deferred renewals is charged to "Loss and Gain" and credited to "Reserve." On the other hand, even in such a case, there may be items which do strike a fair average from year to year so that no reserve allowance will be required for them, for instance, the consumers' meters which may be tested and repaired or condemned once every five years.

Mr. Carter says of the theory of depreciation "when applied by an alleged expert to the property of a utility whose rates were under review, it amounted to this: This plant when new had a life expectancy of 45 years; it is now 15 years old, 33⅓ per cent. of its value has vanished. Its present value, therefore, is 66⅔ per cent. of its reproduction cost, and on that valuation only is the utility entitled to earn a return, and there the theory ended."

It is true that certain men who pose as experts did and do yet so argue. But that does not prove that a reserve for deferred renewals should not be carried on our books of account. Personally, I have, from the first days of commission control, contended against this absurd interpretation of the "depreciation theory." And because the commissions and courts, in the absence of a complete understanding of the questions involved, and acting, perhaps, under the pressure of public opinion and clamor, have accepted this false interpretation of a correct theory, does not furnish an adequate reason for departing from a proper and safe practice.

I also disagree with Mr. Carter in his statement—"No two writers on the subject of depreciation, who are exponents of the theory, agree." I am encouraged to persist in doing my

share towards the development of what I believe to be a correct answer in practice to this important question by the knowledge that there are not a few—and the number is increasing—who believe in establishing a reserve for periodic and final renewals, and yet do not believe that the carrying of such a reserve gives warrant for deduction from plant value. I have faith to believe that many more will yet be found holding this belief.

Mr. Carter refers to Professor Allyn A. Young's writings on this subject. But Prof. Young speaks of a company putting "part of its gross earnings into an absolutely useless depreciation fund." Also, he speaks of those who in this connection are "misled by a bookkeeping fiction"; and of "maintaining a perpetually idle reserve for accrued depreciation." Evidently Prof. Young has in mind something quite different from a reasonable and necessary reserve. I do not suggest an "idle reserve." I do not suggest the accumulation of a reserve which shall not be charged against later. Apparently Prof. Young's experience has been with more extended plants than the ones I have more particularly in mind. If he is speaking from experience, he has come in contact only with cases in which the reserve has been based upon too liberal estimates, or else the expenditures for the deferred renewals have not been charged against the reserve. *I have known of such cases,* I am sorry to say.

I am glad to note, however, that Prof. Young, like Mr. Carter, is opposed in general to deducting for "depreciation," though he makes an exception in the summary of a paper in the *Quarterly Journal of Economics* for August, 1914. He concludes as follows:

"3—In valuation for purposes of rate control, no deduction should be made on account of depreciation of *large and varied* properties, except for depreciation allocated to a period in which depreciation accruals were regularly charged to operating expense."

It is to be noted that Prof. Young confines this proposition to "large and varied properties."

I am glad to find that Prof. Laughlin, as quoted by Mr. Carter, also is opposed to deducting for so-called depreciation, and makes the point that a property which is maintained by the investor *should be allowed to earn on the full investment so maintained*. My point simply is that the investor should be allowed to spread the cost of maintenance as uniformly as is practicable over the years of service.

I also agree with Prof. Gephart as quoted by Mr. Carter, if it is understood that his objection to a *continuing* allowance for depreciation reserve is confined to cases in which the accumulation is in excess of all reasonable estimates as to future needs.

It is encouraging to find still another economist, Prof. Haney, declaring against the theory that a plant is steadily depreciating as to efficiency during its life, and so condemning the proposition to deduct for depreciation in plant valuing.

I think that Mr. Carter's quotation from Mr. Allison shows where Mr. Carter and I disagree or, rather, appear to disagree. We are both firmly opposed to deducting for so-called depreciation, or deferred expenditures for renewals, but Mr. Carter goes further and condemns the depreciation reserve; and this, I presume, because it gives the commissions and courts an apparent reason or excuse for so deducting.

Mr. Allison says "there can never be a need for all of the fund which has accumulated from theoretical depreciation charges made from the installation of the property, *i. e.*, a part of the fund will be useless, so far as renewals are concerned."

My reply to Mr. Allison and so to Mr. Carter is that in such a case it is shown conclusively that the cost of deferred renewals or replacements has been or is being over-estimated. Mr. Carter says that Mr. Allison demonstrates that in a street railway property if the "depreciation" fund were to accumulate from the first of its operation, after "a complete cycle" the fund would amount to 42.75 per cent. of original cost and therefore this amount would never be decreased if the annual allowance were maintained. I would suggest that if the

deferred renewal costs were thus over-estimated, the fund would, of course, continue to accumulate indefinitely.

If the *total* annual expenditures for renewals do become practically uniform, *from then on* no annual contribution to the depreciation reserve need be set aside for renewals. *But we still have the liability for the period prior to the time when this condition of uniform annual renewal expenditures developed.* If the contributions to the reserve had been *correctly* estimated and computed on *the sinking fund basis,* then the interest on this reserve balance will be continually required for its portion of the annual renewals and replacements, and will so provide its proportion of the total annual cost thereof. It is to be borne in mind that in practice there cannot be in the case of a growing property a complete cycle. A complete cycle would require that the cycle be measured by the part of plant of longest life, which must be a multiple of the lives of all the other parts. In practice, even if the plant were not growing, there could hardly be any such condition, and as a result, at the end of the longest life, there would be an overlap of liability for the parts whose lives were not factors of the longest life. Then in this case there will be at the end of the so-called cycle a liability for the renewals shown by this overlap, and there should be in the reserve an amount well equal to this overlap of liability. The interest on this balance to credit of reserve would be part of the annual requirement for renewals and replacements. In such a case, this balance in the reserve account is necessary as representing the accumulated liability for deferred renewals at the time the annual expenditures therefor became practically uniform.

I notice Mr. Allison bases his calculation on the straight line method. Also, that he assumes the amount required for deferred renewals ("depreciation" reserve) is susceptible of being mathematically determined. Nothing could be farther from the truth. And the authorities Mr. Carter quotes, all help to sustain my contention that the amount of annual contribution to the depreciation reserve should be subject to constant correction and, should the accumulation at any time show

a greater amount than the *renewal liability* then in evidence, it simply shows that the renewal reserve has been over-estimated in one way or another and that the checking up process which I included in my proposition has been neglected.

I wonder if it is not this abuse of the renewal reserve scheme which has given the commissions and courts some justification for deducting for depreciation? Mr. Grunsky is also quoted as having demonstrated a 40 per cent. surplus in the depreciation fund, his computation having been made on the sinking-fund plan. Again, the annual allowance was greater than required, or else he loses sight of the lap-over liability for renewals. It requires no mathematical demonstration to show that if such an amount is set aside each year from the income as will with compound interest accumulations exactly pay the net cost of the renewal or replacement of the parts of plant to be retired from service, there can be no surplus. A difficulty is introduced through the impossibility of making an exact prophecy as to the life of plant and the effect of additions thereto. But this difficulty is minimized by the exercise of common sense and common honesty in the periodic verification of the life estimates. The annual allowance should be ample at the first. As time goes on, if it is seen that the reserve is building up beyond the probable requirement, a correction should be introduced in the estimate, and the surplus, actual or surmised, can be reduced to or held at a maximum limit as a reserve against extraordinary contingencies of all kinds, as already touched upon in connection with my references to English practice.

Mr. Carter's second quotation from Prof. Young in no way is opposed to my proposition, though it does tend to show that Prof. Young has but little idea how the cost of renewals falls unevenly upon the years in the case of many public service and other manufacturing corporations whose properties are not "large and varied."

Prof. Young, as quoted by Mr. Carter says: "But if such repairs (he has previously indicated that renewals and replacements are grouped with repairs) are fairly regular in amount

year by year, there appears to be no inexorable reason why a fund to provide for them should be accumulated in advance, and especially a fund that will amount to much more than the annual cost of the repairs."

The trouble here is in the "if." I am quite prepared to acknowledge that there is no occasion for a reserve if there is no occasion for it. And of course there is no warrant for a reserve of $2.00 to meet a $1.00 renewal cost. But I am arguing for the right and the accounting propriety of setting up a renewal reserve where and when the renewal expenditures fail to fall on the years with some degree of uniformity, as is the fact in the majority of cases. Even with Prof. Young's "large and varied properties," it may be advisable and proper to have a moderate and strictly limited reserve for extraordinary contingencies. And in the cases where a renewal reserve is justified under the conditions I have named, there is no more justice in deducting for so-called depreciation than if no such reserve had been set up, as in the cases of "large and varied properties" particularly referred to by Mr. Carter and the authors he quotes.

As to Mr. Carter's criticisms of the rules set up by *some* of the commissions in connection with "depreciation" (deferred renewals), I certainly have no objection to make. And rules for the treatment of this subject must be elastic to be fair, as has, I hope, been indicated in my paper and this discussion.

In conclusion, I am again impressed with the futility of most of our discussions on questions at issue. I have felt it necessary to disagree with some of the points offered in detail by Mr. Carter. And yet, I am now able to agree practically with Mr. Carter's proposition *as expressed by and confined to his summary*. He says—"All the above objections will be obviated if commissions shall prescribe that utilities shall set aside monthly, out of their earnings, such amounts as will be required for maintenance of plant and equipment, including repairs and renewals; . . . and that against the fund thus created there shall be charged actual expenditures for repairs and actual value of property withdrawn from service."

Mr. Carter particularly stipulates for the privilege of distributing over a period of years the cost of extraordinary large units withdrawn. This is the essence of my argument in favor of a renewal reserve. But here it must be borne in mind that an amount which would not appear to Mr. Carter to be extraordinary in connection with the operations of the "large and varied property" of his great company might be extraordinary in the case of a majority of the gas companies of the United States.

The same principle should apply to all cases, and the renewal reserve as I propose, can be applied to all cases, because the reserve requirement will grow less and less as the annual expenditures approach nearer and nearer to uniformity, until finally with practical uniformity, the annual contribution to the reserve will theoretically reduce to zero, the current expenditures for renewals being covered by the direct charge against the rates plus the interest on the reserve balance. It may here be noted that even in cases where the annual expenditures for renewals and replacements have become practically uniform, Mr. Carter prefers to keep the way open for spreading extraordinary expenditures over a period of years.

Finally, what I am contending for is, that in the case of a property honestly and economically managed, including the maintenance of the plant at a high degree of efficiency, we should have the privilege, when necessary, of spreading the cost of deferred plant renewals and replacements over all the probable years of service of each part of plant by means of certain accounting processes, so that we shall not deceive ourselves as to our annual profits, shall place the current burden for up-keep where it belongs, and also we should enjoy this privilege without affording an excuse to commissions and courts to deduct this reserve accumulation from cost new of the plant by reason of a supposed acknowledgment on our part of actual plant depreciation.

THE CHAIRMAN: This session is now adjourned.

Adjourned, 12:45 P. M.

ACCOUNTING SECTION.

Afternoon Session, Thursday, October 22.

Mr. R. C. Dawes (Chicago), *Chairman,* Presiding.

Mr. T. M. Leahy (New York), *Section Secretary.*

The Chairman called the meeting to order at 2:10 P. M.

The Chairman: Is Mr. H. C. Schaper, of Milwaukee, present? If so, we would be glad to have him begin the reading of his paper on "Compensation of Meter Readers."

COMPENSATION OF METER READERS.

About a year ago the Milwaukee Gas Light Company decided to change its method of compensating meter readers from the old system of paying a certain rate per hour, irrespective of the number of readings taken, to its present method of paying a certain rate per hour with a minimum return of a specified number of readings per hour, and for readings over and above this minimum return, to pay a bonus.

The reason for making this change was primarily to establish a system that would more equitably compensate meter readers for actual work done. Some basis of what should constitute a reasonable hour's work had been in a manner established through years of experience, although districts vary greatly, some localities offering opportunities of reading meters easily while others are harder to get and a smaller number are read. Furthermore, conditions are likely to change in the same district so that an average per hour basis does not in every case truly decide whether or not a reader has done an honest hour's work.

In 1907 our Company abolished separate rates for fuel and illuminating purposes and began to remove duplicate meters. It was natural that this should reduce the average returns per hour, and when this work was practically completed it was necessary to establish some new basis of an hourly return. To determine this, we picked five men at random from our reading force and placed them upon a monthly basis. They were paid

$60.00 per month, irrespective of the number of hours required to work each day, but we did make a provision that no more than eight hours were to be put in in any one day. We had been getting an average of 25 readings per hour, but by making this change we increased this average to 30 per hour. This average was obtained not only from the monthly men but from the day men as well. After several months trial, we concluded that the average of 30 readings per hour represented a reasonable return, and this was used as a basis for our present method; a merit basis of compensation and which is as follows:

New men are paid 24c. per hour and with continued service this rate is gradually increased to 27c. per hour. For this a minimum return of 30 readings per hour is expected, so that our primary labor cost is from 0.008 to 0.009 per reading. For readings taken in excess of the 30 per hour, the men receive extra compensation at the rate of 0.008 per reading, this rate being paid to old men and new men alike. This has made it possible to do our work with 22 men who are in charge of one supervisor and at an average cost per reading of 0.0105, including the cost of a supervisor and miscellaneous expenses. Under the old system it required 26 readers with one supervisor at an average cost of 0.0125 per reading.

We have in no case so far found it necessary to fine a man for not bringing in the minimum number of readings per hour, and whether we would feel inclined to do this or not, I question very much, as a man who could not bring in the minimum number of readings per hour would hardly be considered competent for the work and would be discharged.

At the end of each of the three reading periods, each man reads his own stragglers and retakes for which he is paid a flat rate of $1.25, irrespective of how many or how few he may have. Our purpose of having this flat rate is to encourage bringing in as few stragglers with the regular readings as possible and the fewer stragglers a reader has, the easier he will earn his $1.25. I find that men will now make

a second call to get the reading at the regular period rather than bring in a report of "not at home," as it lessens his work on straggler day besides paying him the bonus on regular reading days. As evidence, I submit the number of stragglers we had for March 1913 and March 1914, which were 4,536 and 2,698, respectively. Another reason and a more material one is to avoid the making of stragglers purposely.

Stragglers and retakes naturally are scattered and it would be unreasonable to expect these read at the regular reading rate. If we were to pay some equitable rate per reading, and which of necessity would have to be considerably higher than the regular reading rate, the meter reader could then purposely fail to read some meters at the regular reading time and report them as stragglers and receive the higher straggler rate of pay. With this flat rate of $1.25 this objection is overcome.

We have approximately 200 meters that are read weekly and, as these are considerably scattered, we pay a flat rate of 30c. per hour. This rate is also paid when special readings are taken.

Our work is so arranged that the meter readers also deliver gas bills and this work is likewise paid for on the merit basis. The men are paid the same as for meter reading, from 24c. to 27c. per hour, and for which a minimum delivery of 65 bills per hour is expected. For each bill delivered over this average, they receive extra pay at the rate of 0.004 per delivery. This has resulted in reducing the cost per delivery from 0.0062 to 0.0053.

It occasionally occurs that we have special work for the readers which can be done in connection with their regular work, such as delivering advertising matter or making canvasses. Frequently we have advertising stickers attached to our gas bills and for attaching these stickers, we pay them 5c. per hundred and for delivery an additional 5c. per hundred. Some months ago we made a canvass of large dwellings having certain types of heating apparatus and for each prospect accepted by us the reader was paid 5c.

The average wages paid during the past eleven months, the period covered by the present system, has been $61.48, compared with a previous average of $55.21. The maximum average earned by one reader during this period was $71.45, and the maximum for any one month by one reader was $75.89.

Another result that we have accomplished with this system, and one that will readily commend itself, is that our men always appear busy, as it is natural that loitering will pay them nothing. To see a busy man read his meter inspires a consumer with more confidence than to see a boy and sometimes a pair of them fooling away part of their time.

Our readers apparently are very well satisfied with this merit system and probably the best evidence of this is the fact that we have had no men leave us since it was inaugurated. Our men are taken from all walks of life and we have amongst our number of readers, mechanics, former school teachers, artists, musicians, ball players, etc. Whenever necessary to call in an extra man to help out, we usually do so from students of the high schools, normal school, or the university.

Our men are uniformed, the uniform being of approved design and is made for us by one tailoring concern. The uniforms are charged to the men and they pay for them in installments of $3.00 per month. No objections have been raised by any of our men because they are obliged to wear uniforms and by having them uniformed, they present a neater appearance and are readily recognized by consumers as a gas meter reader.

In addition to this we aim to keep our readers in the same district as long as we possibly can, as greater confidence in the reader is gained as he becomes familiar to the consumer. We are opposed to any system of trying to check up the readers that will require frequent changes of reading districts as this surely is an annoyance to the consumer. We endeavor to get reliable men and then trust them and our trust in them has so far not been misused.

We use a coupon reading slip and cut off the previous months

reading before the slips are turned over to the readers for the next month's reading, so that no reader can tell from the slip what the previous reading was. We also get a check on the readers with our meter changes, and while this may not check up a reader for periods which may sometimes cover more than a year, the reader is constantly in the dark as to just when such a change will be made and he will not risk his position knowing that any time he might be found out.

Have a force of readers, composed of reliable men, have them neat appearing and easily recognizable by uniforming them and who always appear busy and on the job, and you have opened the way to a greater confidence of the consumer which will help in a large measure to a satisfied consumer. It is a rare occurrence for us to receive a complaint against a meter reader and it has been some eight or ten years since we have had a complaint serious enough to cause dismissal.

THE CHAIRMAN: The subject is open for discussion.

MR. WALTON FORSTALL (Philadelphia): I am speaking with diffidence as one unfamiliar with the details of meter reading, yet it seems to me that Mr. Schaper is to be congratulated on the success of his application of scientific management to the local meter reading situation in Milwaukee. In reading his paper, I do not find any statement as to the number of hours the day-rate men work per day and per week. Also, I believe that a statement of the number of reading errors under the new system as compared with the old, would add value to the paper.

I have been asked to read the following anonymous comments on this paper:

"There is one thing to be considered about a bonus system for meter reading, which is that the men, in order to make as much as possible, will work at high speed, at a nervous tension, and eventually the company may become loaded up with men who have over-exerted themselves in an effort to increase their pay.

"The Milwaukee paper does not bring out under the bonus plan what their intentions are regarding a man who has been competent, but, owing to the high pressure under which he has worked, has gradually become unable to maintain the average number of readings, and in this connection we are wondering what arrangement they have in Milwaukee to care for a meter reader who becomes incapacitated through a temporary illness.

"In connection with the statement that some localities offer opportunities for reading meters easily while others are harder to get, it would appear to me that unless they have an average for the suburban and scattered district, the men in the latter district would be unable to make as much as the men in the congested district, which would have a tendency to cause some dissatisfaction among them.

"The paper does not so state, but if their meter readers are not required to report at their office in the morning, but permitted to go direct from their homes to their districts, taking their records with them, I would state that this I do not approve of, but believe that all employes should first report for duty to the office.

"While the paper states that they have not found it necessary to fine a man for not bringing in the minimum number of meters read per hour, they do not state if any penalty is imposed for overread meters. A man may read a larger number of meters than another man, but the man having read the greatest number of meters may also have a larger number of overread meters which require the second visit to verify the index, while the slower man may have read fewer meters, but have made a less number of errors. Perhaps Milwaukee penalizes a meter reader by giving such cases to him when he goes after stragglers. I am wondering whether, under this bonus system, the number of high bill complaints show any increase due to incorrect readings.

"The paper states that at the end of each of the three reading periods, each man reads his own stragglers and retakes, for

which he is paid a flat rate of $1.25 irrespective of how many or how few he may have. If the meter reader has only to make one call on stragglers, the $1.25 would compensate him.

"In our city, owing to the large foreign population, and in the textile districts where all the members of the family are employed in the mills, we have some route books on which we do not obtain over 50 per cent. of the meter readings at the regular call, consequently we have a large number of meters where we are obliged to have our men make several calls and eventually call at night in order to obtain statement and remove the money from the meter.

"Now I would like to ask Mr. Schaper, how would he handle a situation where he had a great many pre-payment meters, also a fair number of monthly meters mixed up with a large majority of quarterly meters, and there was no way of getting rid of the quarterly meters unless people requested monthly bills?

"Again, the record of performance of Mr. Schaper's meter readers apparently allows but two minutes a meter. This only seems possible if in Milwaukee there are two or more meters on the same service."

What I have read is not intended as a criticism of Mr. Schaper's paper, but simply to bring up conditions that are different, in order to get some constructive ideas from Mr. Schaper as far as is possible from the rough description I have given, how he would handle that particular situation, which just now is being handled on a straight day-rate basis, with no particular inducement to the men to do the utmost possible work, except the general inducement that the worthy employe, we will say, will finally get more money.

Mr. W. H. Rogers (Paterson, N. J.): I also appreciate that this is a very well-written and instructive paper, and I want to ask two or three questions for my own improvement. For the purpose of comparison, I would like to ask the total number of meters in use in Milwaukee, and how many of those are prepayment meters?

I would like to ask if the supervisor reads meters, or simply superintends the work of his men?

And then, just what is the meaning of three reading periods? In Paterson we have one reading period for regular meters, and of course pre-payment meters are read at another part of the month.

In delivering bills, do the meter readers ask for payment or accept payment if it is tendered?

We have found that where it could be worked out, it is perhaps a good plan to select meter readers from shop men, but that has not worked out as well lately as it did in the past, because we found that it interfered with the organization of the operating department. I suppose that Mr. Schaper has found the same thing, because he gives us a number of former avocations, such as mechanics, musicians, ball players, and so on.

The paper is very instructive, and especially on a question which I think is comparatively new and one in which we can all make improvement. We pay regular salaries, ranging from $60.00 to $75.00 a month.

THE CHAIRMAN: Perhaps it would be a very good idea to give Mr. Schaper an opportunity to answer some of these questions, before a lot more are accumulated, if you would like to answer them now, Mr. Schaper?

MR. SCHAPER: I will, Mr. Chairman. The first question brought up was about the high speed. It is true that if you offer the men a bonus they are liable to over-exert themselves; I have found that to be the case. Some one may be a little bit over-anxious to get as large a pay check as possible. If that condition presents itself, I usually curb it. You can tell pretty nearly what is a reasonable day's work, and if a man runs above that number, I usually "call" him on it.

This system has affected one of our oldest, in fact our oldest, meter reader. He is a man well over 60 years old, and unfortunately, he is earning less money now than he did before, but we have simply got to attribute that to old age, that is all.

We are doing nothing except to pick out the easiest districts for him.

The difference in districts is something that we have got to watch for continually. It is true that some men will get easy reading districts, other men will get hard reading districts, but we try and equalize them so that no one suffers more than another, and it has worked out pretty well.

I don't know what the object is, or the real necessity, of having employes report in the morning. Our readers report in the evening, at five o'clock, and they report their work for the day and take out their work for the following day. We do not restrict them to starting out at any one particular time, although we would not have them start before seven in the morning or possibly much after eight. That is something that can be controlled pretty well, I think, by the quantity of work that is brought in every day. It is really immaterial whether a man starts at seven-thirty or eight-thirty, as long as he gets in his eight hours and is able to report by five o'clock. Now there are lots of men who would rather work the eight hours right through, without stopping for any lunch; and I don't think that we need raise any objection to that. In fact, we have found that the more readings that can be taken before one o'clock in the afternoon, the better you are off, because after one o'clock it frequently happens that the women get ready to go out for the afternoon and the reader finds the premises locked.

The errors in reading meters have not increased since establishing this system. Unfortunately, I have not a record, that is a comparative record, of the errors in readings under the new system and under the old. I have always had a report brought to me of the errors on each man and checked them up; if anybody needed calling down he got it, and I paid no further attention to the records. But this year we have kept track of the errors,—have saved our records, and up to the present time, the average errors have been 58 per month, out of a total of 93,500 readings.

Our high-bill complaints have not increased any; I don't

know why they should. The meters are read the same as before, and it has absolutely no bearing on high-bill complaints.

In taking re-takes, we expect a man to make only one call. If he does not get it then, we either send an estimated bill or pass it up for a month.

We have no pre-payment meters in our city. Neither do we have any quarterly bills, so the question of how I would handle such a situation, I am not prepared to answer without giving it some thought.

We have a supervisor over the meter readers, and he does not read meters.

Our three reading periods come about through the subdivision of the city. The city is divided into three districts, and bills are rendered on the 10th, 20th and 30th of the month, and the reading periods correspond.

We do not permit our men, when they deliver bills, to accept payment.

Of course the question of shop men does not enter into consideration with us, because our meter readers are practically employed all the month around; we have a separate force for that purpose.

That, I think, answers all the questions that have been put to me so far.

Mr. H. W. Peck (Schenectady, N. Y.): In Schenectady we have had the continuous reading system for a great many years, and like most companies have found that 75 per cent. of the calls where we are unable to read have been in the afternoon. On the first of this year, we started the system, which has worked out very admirably, of making all our regular readings in the morning.

With a total of approximately 30,000 gas and electric meters—the former in the cellar—the latter in the attic—we have eight meter readers and one supervisor or chief reader, who does no reading except for some special cases where we want him to investigate personally. I have a record here for March, April and May of this year; they are so nearly alike

that I will read the figures for March only. We read in the morning, with eight men, 23,785 meters, or a total average per man per morning of 119; and at four hours a morning, 30 meter reads per hour.

In the afternoon, four of the meter readers stay inside, on ledgers and on miscellaneous clerical work. The other four we use for special readings, for pre-payment meters, of which we have about 1,800, and for skips of the morning readings. We read in the afternoon during March, 6,380, or an average per man per afternoon of 64, as against 119 in the morning.

There were 1,121 skips in the morning. Of those, we were able to get in the afternoon only 612. Others we were unable to get in at all during the month. That 612, then, really represents the skips for the morning, out of a total of 23,000, or is only 3 per cent. That is certainly a very low proportion.

We pay our men on a weekly basis, starting them in at $10 a week and raising them as a rule, about $1 a year, with a maximum of $15, and by that time, or before we try to transfer them to work either as regular ledger keepers or to the commercial department or some other department. We use young men entirely. This arrangement has worked out to the great satisfaction of everybody—the meter readers and the accounting department.

Mr. C. M. Cohn (Baltimore): I would like to say something in behalf of the meter readers, who are usually overworked and underpaid. I am very often confronted with persons seeking employment, and they offer to do any work, "even reading meters." That is a remark made because of lack of understanding of the responsible and hard work that is done by meter readers in their every-day work.

The meter readers, as a rule, are kept very busy, and they are held to a high degree of accuracy in their work. In addition to that, the very work they do consumes considerable physical energy as well as shoes and clothing.

There are several remarks I noticed as I read this paper. One of them was with reference to delivery of gas bills by

meter readers. I question whether that is an economical arrangement for gas companies; it would seem that a class of employes perhaps of not quite as high grade as it is necessary to have for efficient meter readers, could just as well do that work at considerably less expense to the company.

Our efforts in Baltimore, with reference to the delivery of bills, started out with the meter readers delivering the bills, and we later jumped a little too far in the line of economy by substituting boys. We soon found out that the boys were keeping us in hot water, and it paid us to get men to deliver the bills. The work of delivering bills is very simple, and there is a class of men in every community whose earning capacity is very small, and who have practically little or no ambition and who are willing to go along on some easy-going job and do the work well, and be perfectly satisfied not to get any further advancement. We got hold of men of that type, and our troubles with complaints regarding the non-delivery of bills stopped, and the scheme worked out very well. The pay of those men is about 33 per cent. less than we pay the meter readers.

I notice a reference to the men being uniformed. That is a problem that we have thought over a number of times. It seems to be all right in theory, and I am glad to see that it works out well in practice in Milwaukee. Personally, I think that the men ought to be uniformed so that they can be readily recognized as agents of the company when they attempt to or in fact, do enter houses for the purpose of making readings of meters, and I personally would like to see that practice adopted in Baltimore, and in fact it will be adopted there at such time as we feel that it can be done without unnecessarily disturbing the men.

I notice also a remark with reference to the coupon reading slip, which is apparently a scheme to prevent the previous month's reading being known to the meter reader at the time that he makes a reading, and thus is intended to prevent the falsifying of the returns of meter readings. I think that there

ought to be some check on the reliability of the men and the readings that they make. This coupon scheme, however, is perhaps going further than the conditions ordinarily would warrant. In Baltimore, we have not found it necessary to go that far. We have several plans that are intended to keep a check on the men. In the first place, we endeavor to get reliable men, and we endeavor to have working conditions that are satisfactory to them. We keep a check on the number of meters they are required to read, so that they will not be overworked, and we do not usually allow the same meter reader to read any meter more than three successive months, so that there is a constant rotation of meter readers, and that of course is a practical check on any continuous falsification by one man.

We also do not enter on the meter reader slips during any month the changes in meters; in other words, the changes in meters are not recorded on the meter reader slips until after the next succeeding regular meter reading date. It is consequently impossible for a meter reader to say, in any particular place, whether the meter has been changed or not, and if he should falsify the returns by putting down a fictitious reading, the reading would not check with the previous reading of the old meter.

We found that there were quite a number of instances reported by our men, of places where they were unable to make readings for one reason or another, and we undertook to make a tabulation of all such cases, and thus we were able to find out which men had the most of such cases, and we found from that that there were some men who habitually had the largest number of such cases; and after awhile the conditions improved, because those men were asked to explain why it was that they had so many more than others, and the result was that the number of such cases decreased. It was obvious that the men, no doubt, made some perfunctory effort to get into apparently closed houses, and failing, they felt they had done their full duty and passed on, and did not make any further

effort later in the day, although they may have had time to have done so; but when they found that there was a check on them, they made greater efforts, and if they did not succeed in the first instance and had the time, they went back and tried again.

Mr. W. D. Kelley (New York): If I may begin at the end, I want to congratulate Milwaukee on the fact that it has been eight or ten years since they had a complaint serious enough among the indexers to cause dismissal. I wish we could say that.

My sympathy goes out to the old hand who lost out through the "speeding up system." The old man's experience must greatly encourage those who are still keeping up the pace.

Twice in this paper is mentioned the desirability of appearing busy, *appearing busy*. Are they busy? Why is it so essential to appear busy?

We have no teachers, artists, musicians, or ball players for our indexing work. We would like to get a higher grade of men than we have, but are doing the best we can.

Mr. Schaper says the errors are about 58 per month, is that right?

Mr. Schaper: That is the average, yes sir.

Mr. Kelley: I would like to say that in proportion (and we index about 300,000 regular meters per month) our errors are a little less than one-half of that.

Our indexing is done from the shop, none of our books going out for the full day. Mr. Peck, by indexing in the morning only, is to my mind, working along good lines. We find in certain districts in New York we can do better by starting at seven o'clock in the morning, than we can by commencing at eight o'clock. We work eight hours only, and when the indexers start at seven o'clock they quit at four o'clock.

We have peculiar conditions in Manhattan. About 50 per cent. of our meters are in cellars, probably 10 per cent. are in stores and other locations fairly accessible. The balance or 40 per cent. are located in living apartments where the index

cannot be had unless someone is at home and at the same time willing to admit us.

Our rate of pay is about the same as Milwaukee. You pay 27 cents per hour, less the bonus. Am I right?

MR. SCHAPER: Plus the bonus.

MR. KELLEY: That is your maximum?

MR. SCHAPER: No, no, that is the base rate, 27 cents an hour. They get that for 30 readings. If they read 40 readings, they are going to get a bonus on 10 readings.

MR. KELLEY: I see. I beg your pardon. We pay a bonus of 25 cents on every correct book. This bonus is not paid for time, or for speed, it is paid for accuracy only. We have about 1,400 books. These books are due in at various times from one o'clock to about four o'clock and we know when they are due. If the man is green on the route or if the weather is very stormy or very warm. we make some allowance on the time.

The week before last, we received 1,632 orders after our men had gone out at one o'clock and all of these orders had to receive attention the same day. You can readily see the great advantage to us of having short books and bringing them in early.

The 25 cents is not paid until a full month has elapsed from the time the meter was read, thus giving a sufficient period for errors to become known. Our meter reading costs about 89 cents per 100 indexes taken without bonus, and 95 cents per 100 indexes taken including the bonus. Many of our men get from $4.00 to $5.00 per month in addition to their pay through the bonus system, which I think I said before is paid for accuracy only. Our rate of pay to meter readers would be higher than it is, but for the fact that in our school we hire young men, usually 19 or 20 years old at $1.50 per day. These men are sent to our School of Instruction and as soon as they

qualify in their first study, they receive an automatic increase of 25 cents per day on the Monday after qualifying.

The first study in our school is meter reading. This is not because we expect to use the students as meter readers permanently, but rather because we feel that the man should learn indexing before anything else. After having qualified in the study of meter reading, the young man may be kept at this work until he has passed in the next higher study.

While we usually have a certain number of students, as we call them, doing meter reading, we have always a large number of older and more experienced men on this work who receive a higher rate of pay and who after finishing their daily meter reading work execute orders of various kinds.

Mr. W. M. Halsey (Newark): (Written discussion communicated.)

Delivery of Bills, May, 1914.

2,206 hours.....		$684.98	primary labor cost $0.0059 per bill
Number of accounts	104,283	27.60	carfare
Gas sundry sales	8,937	2.43	5 hours time
Electric S. S.	1,327	8.42	27 hours time
	114,547	$723.43	Average per bill $0.0063

Collections on presentation, May, 1914 (flat rate) .. 31.5 %
Collections on presentation, May, 1913 (discount) .. 32.7 %
Total collections for month of May, 1914, (flat rate). 53.64%
Total collections for month of May, 1913, (discount) 42.19%

Delivery of Bills, November, 1911.

2,006 hours at 0.306 per hour.....		$613.836	average per bill $0.0073
Number accounts, gas..	75,304	23 60	carfare
Gas sundry sales.....	8,000	2.43	5 hours time
		8.42	27 hours time
	83,304	$648.286	average per bill $0.0077

Average bills delivered per hour, May, 1914..... 52 bills
Average bills delivered per hour, November, 1911 .. 41 bills

GAS AND ELECTRIC, MAY, 1914.

Average readings, individual, from 35 to 67 per hour.
Average readings for Newark district, 49¼ per hour.
Average pay per hour, 26¢ to 36¢. Average for district 0.306.
Total scraps, month of May, 1914—2,080.
Average per cent. of scraps, 1.98.

65 men—

$635.878	primary labor cost per reading 0.00608
2.43	5 hours time
8.42	17 hours setting up books
	10 hours checking records
33.00	carfare indexing
18.54	batteries and bulbs
$698.268	total cost per reading 0.0066

Number of meters 104,487, gas and electric.

NOVEMBER, 1911, GAS.

Average readings per hour (gas only), 38½.
50 men—

$603.738	primary labor cost 0.00802 per reading
2.43	5 hours time
8.42	27 hours setting up books and checking records
25.00	carfare indexing
15.48	batteries and bulbs
$655.068	total cost per reading $0.0087

Number of meters, 75304.

The increase in average readings per hour, and the decrease in labor cost per reading, and number of scraps for May, 1914, over November, 1911, is due to the combining of gas and electric readings, and a merit system of checking each day's readings against the same day of the previous month, showing the gain or loss. The reader showing the highest average of readings per hour for the month is placed first on the list under the head of readings per hour. The next highest is placed second, and so on. The reader showing the smallest number of scraps is placed first on the list under the head of scraps regular readings, the next lowest second, and so on. The record of daily collections is also checked against the same day of the previous month, noting the gain or loss in the day's work. These records are used to determine the men that are

entitled to promotion and salary increase. The men knowing this, strive to improve their records from day to day.

Mr. C. S. Ritter (Detroit): Written discussion communicated.) I believe the Milwaukee Gas Company is getting about as good results from its method of paying meter readers as could be obtained by any system of compensation it might adopt. At least, we must recognize the fact that it is depending on physical effort for its meter reading, and the results it can obtain through any system of wages are definitely limited by the physical endurance of the readers. An average man accustomed to walking can do a mile in 14 minutes, but it would be quite impossible for him to walk a mile in 13 minutes and continue the gait for six or seven hours without a serious state of fatigue. It is quite evident, therefore, that after a man has cut out soldiering and picked up the lost motion, which the piece work plan will stimulate him to do, and has otherwise struck his natural gait, very little more can be accomplished through a "speeding up process." In fact, we should see to it that he does not overexert himself and thereby lose his efficiency through an "all in" feeling from which he cannot recuperate without loss of time or because of which he may become discouraged and give up his job.

"Human fatigue," says Holbrook Porter, "mental and physical, is like fatigue of metals. Up to a certain point, stress may be applied repeatedly and recuperation to a normal condition is effected by nature, but beyond this elastic limit, fatigue is cumulative in its effect, and natural processes cannot restore the injury which has been produced except by a period of rest and specific treatment."

Unquestionably, the piece work plan has a strong tendency to cause overexertion, particularly if the meter reader is in sore need of money.

Detroit has often considered a piece work plan, but, for the fear of over stimulating readers, had always abandoned it, until August of this year, when inspired by the success of the Milwaukee Company we decided to try it out. We were already

getting good results, however, the essential difference between the Detroit and Milwaukee plans being only that Milwaukee readers were on a direct piece work schedule and might increase or decrease their daily wage at will, while Detroit readers were paid on a per diem schedule based on past results, and had to demonstrate for two or three months that they were entitled to an increase in their rate before it was granted. The main drawback to the plan was that it was not self-adjusting, and the profit to the readers was too remote from the increase in their efficiency to secure the maximum results. Compared with Detroit, Milwaukee was getting better meter reading results, although their bill delivering costs were higher than those of Detroit, a condition I am unable to account for.

Though still fearful that it might inspire the men to overwork, Detroit started the experiment with a modification of the Milwaukee schedule on September 1st. The indications are, so far as we can judge from our short experience, that the men will make about 18 per cent. more per month, and the company will save about 12 per cent. of the cost of reading under the following schedule, which is the one we finally decided to adopt.

$2.00 per day for 200 readings.
.008 for each additional reading.
.015 for each pick up or straggler.
.05 per day for each of first two 6 months' periods of continuous service, and
.05 per day for each year thereafter.

You will note that we give $0.015 for each pick-up instead of a flat rate per month for all pick-ups. This is about half the former cost and has the same advantage of diminishing their number that the Milwaukee rate has, without some of its disadvantages.

The bonus of $0.05 per day for each period of continuous service is given in recognition of their faithfulness and reliability.

It may be of interest to know what a meter reader does

with his time while on his route. For my own satisfaction I made a personal analysis of their work. I carried a pedometer and the meter reader another, each being tested for per cent. of error. The following is a representative day's work:

July 31, 1914, meter reader Sonnenmeyer read 315 meters in 7 hours and 40 minutes.

	Hours	Minutes	Per cent.
Time going to route	1	8	13
Time on street between houses	1	12	15
Time from street to meters	5	20	41
	7	40	

		Per cent.
Miles walked going to route	1.25	7.6
Miles walked on street on route	3.50	21.4
Miles walked in yards and houses	11.66	71.0
Total miles walked	16.41	100.0

Average net time per meter .... 1 minute 14 seconds
Stairways climbed (up and down) .. 175 at 18 ft. = 3,150 ft.
Rate of speed while walking ..... 1 mile in 14½ minutes

No deduction was made for registration of pedometer while going up and down stairways, the effort and time required being much more than enough to offset the error in registration. This record was made on a route a little better than the average.

Sonnenmeyer is only an average man. One of our readers has averaged over 350 meters per day for five years and must have walked at least a distance equal to once around the world to do so.

Mr. W. H. Taylor (Omaha): (Written discussion communicated.) In reading Mr. Schaper's paper, I was immediately impressed with the high rate or number of readings he obtains per hour. His average rate is higher than we are able to reach at Omaha, so that I have been trying to find the reason for it.

The highest rate that we have obtained for a monthly reading period was 224 meters per day of nine hours, while the average rate per day over a period of months has been 168.

Our regular readers are paid $50.00 per month, or $2.00 per day, on a basis of 25 working days. This gives us an average cost of $0.0119 per meter.

I am unable to account for our cost exceeding the Milwaukee cost on any other ground than the following:

According to Brown's Directory for 1914, Milwaukee has 180 meters per mile of main, and Omaha 118. This is 52 per cent. more than Omaha, and it necessarily follows that our men must travel farther per meter than the Milwaukee readers. Whether this will account for all of the increased cost or not, I am unable to say.

It may be that the bonus system in use there may have some effect. We do not use the bonus system; our organization being as follows:

One prepayment meter reader;
One reader for weekly accounts and re-reads on high bill complaints;
One reader for regular and prepayment meters in the South Omaha district;
Nine regular readers for the balance of the territory.

These men all report to our head bookkeeper, who routes them, and also keeps a record of the work performed. This record enables him to get rid of the laggards when necessary.

Every month we use from one to five extra readers who work on the piece-work system and are paid $0.0125 per meter for readings. The use of these extra men enables us to keep our work uniform from month to month, as they are taken on and laid off as required.

Weather conditions and other causes sometimes vary the reading rate, so that by the use of the extra men we are able to speed up when necessary, and thus have each route read, as nearly as possible, on the same date each month. This uniformity prevents unusually long or short intervals between readings, and helps cut down high bill complaints.

Our reading period is from the 5th to about the 27th of the month. During the non-reading period the readers deliver

bills, and do miscellaneous work involved in getting the bills out.

Our readers are also trained to look out for by-passes, and are paid a reward of $5.00 for each one discovered. This has resulted in finding by-passes that might otherwise have been overlooked for long periods.

We do not believe in changing readers' routes for checking purposes. As our readers are not furnished with the previous readings, but each month have new duplicate reading blanks, which are run off on the addressograph, they are unable to fake readings.

We believe our men should stick to their routes, so that by becoming familiar with them they are able to locate the meters with a minimum amount of inconvenience to the consumer. The consumer also recognizes and remembers that he is the "gas man," and then has no hesitancy about admitting him.

In Omaha many houses have but a small cellar under the kitchen, where the meters are located, access to which is by trap door, so it is doubly important that the same man read the meters in one locality from month to month, as he knows where these trap doors are located, and will exercise more care to see that they are closed when he leaves the house.

We have had many damage cases caused by people falling through trap doors into the cellar, due to a careless meter reader leaving the door open. Too much care cannot be exercised by meter readers in visiting homes, for the strength of our organization is but the weakest link in it, and often a meter reader can destroy all the good service we endeavor to give our consumers by carelessness, or by talking too much.

Men should be thoroughly trained in courtesy, etc., before allowed to read meters. This of course applies to all employes who come in contact with consumers.

I believe that the system worked out by Milwaukee is exceptionally good—about the best I have heard of.

Mr. O. B. Busbee (Atlanta, Ga.): The advantages of the hourly system explained by Mr. Schaper are: A larger

number of meters would be read per hour; it may cause fewer scattered meters.

Otherwise, I do not see where the hourly system with its requirements has any advantage over the monthly salary system.

Some of the disadvantages would be that the meter reader would not take the time to do anything but read meters and would neglect to take care of important matters which come up from time to time.

This is true in most any line of business where the man is working piece work, for it is very natural that he should do the assigned work only.

He would not stop, for example, to investigate anything that might turn out to be a by-pass around the meter. He would not stop to investigate a reported leak which should be attended to at once and which might cause a complaint from the consumer when he would receive his bill. It would be hard to make an adjustment satisfactory to the consumer if he was aware of the fact that the meter reader paid no attention to his complaint. He would not stop to investigate a meter to see if it is a non-register.

Some may say that bookkeepers only should report slow and inaccurate meters, but our experience has shown that they are not in position to perform this service as well as the meter readers.

The following will show what the meter readers have done in the past nine months in reference to having meters changed for non-register. Change orders made for 455 meters; the results of tests on these meters was as follows: 238 non-register, 154 slow, 19 fast and 44 correct.

The meter reader under the hourly system would probably not be as courteous to the consumer for the simple reason he would not take the time.

A meter reader working on the hourly basis will not have the inducement to learn the important points connected with the business, or to prepare himself for a better position and

be competent enough to handle the man's work that is ahead of him. I do not believe he would take the proper care of the company's interests, as he would not consider himself important enough to do so. He is aware of the fact that the company has him only for the actual amount of work done by him, and is looked upon as being more like a piece of machinery than he is as an employe.

The meter reader is an employe that comes in contact with every consumer once every month regularly and should be instructed and schooled in such a way that he would be able to answer the many questions that might be put to him, and he should have the time to answer these questions in the proper way.

My opinion in regards to the meter reader having the previous index is that he should have it by all means before he goes to read the meter, as this assists in reducing errors, especially on the 10,000 and 100,000 ft. dials. He can check the previous index against the index that he is taking, and if an error is made, he will see it at once. This would cut down proof reading to a minimum.

If a meter reader should want to curb (guess at index) a meter he could do so just as well by not having the previous index as he could if he did have it, by keeping the previous index in a small book of his own. It is my opinion that this would be more likely to happen with a meter reader on the hourly basis with requirements than with the one on the monthly salary system. The meter reader on the monthly salary system would not be so tempted to curb because he would not profit by it.

You would have the same check on the monthly salary man that you would have on a man reading on the merit system, namely, changes, removes shut off, and the index taken when investigation is made and complaint orders attended to.

The meter reader without the previous index could not possibly tell whether a meter was a non-register or not. He would not visit meters shut off to ascertain whether they were

being used without application, unless he was getting paid for this work.

Our system and results of the monthly salary system are as follows:

Meter readers read 12 days at a cost of $173.04.
Six meter readers read 14,156 meters.
For the month of March, 1914, the cost of reading meters per meter was $0.012 including the reading of scattered meters and proofs.
Meters not read on regular reading were 5 per cent.
Meters not read at end of month were 69.
Number of meters changed for non-register 66.
The report of tests on these meters was as follows: 42 non-register, 18 slow, 2 fast, and 4 correct.
Number of days devoted to delivering bills 4.
Cost of delivering bills, per bill $0.004.

The remaining days in the month are devoted to attending to investigations of high bills. This has proven to be very satisfactory to both the consumer and the company. The meter reader in most every case satisfies the consumer at the latter's home. We have enough of this work during the time that the meter readers are not reading meters and delivering bills to keep them busy, and the company gets value received for the work that they do.

The average monthly salary of the meter reader is $62.50. They start at $50.00 per month.

My experience with the meter reading department covers about 7 years, 5 years devoted to reading and lifting meters.

I keep a record and know exactly what each meter reader does each and every day, and I know at all times whether or not he is doing his work.

REPORT OF SECTIONAL NOMINATING COMMITTEE.

THE CHAIRMAN: If there is no further discussion, we will listen to the report of the Sectional Nominating Committee.

Mr. C. N. Jelliffe (New York): Your Committee reports that it recommends the following names to the Nominating Committee from which to select a Vice-President in October, 1915.

Mr. C. M. Cohn, of Baltimore.

Mr. J. P. Crowley, of St. Paul, Minn.

Mr. G. W. Curran, of Philadelphia.

Mr. Walton Forstall (Philadelphia): Mr. Chairman, I move the adoption of the names recommended by the Nominating Committee.

(Motion seconded and carried.)

The Chairman: We will now listen to the paper on "Printing and the Care of Printed Stock," by Mr. W. P. Baylie, of Philadelphia.

PRINTING AND THE CARE OF PRINTED STOCK.

Introductory:

Not long ago, a newly appointed purchasing agent of a large railroad company made it one of his first duties to systematize the company's printing. By standardizing the paper used, it was found that only four brands of paper, in various weights and colors, were required for the entire work of the company. Other important discoveries were made, and when the investigation was finished, the result meant a yearly saving of 33 per cent. in printers' bills.

What was accomplished in this instance can no doubt be done by many gas companies, for, while considerable attention has been given to certain features in connection with printing, it is questionable whether, in many cases, a thorough study of the subject has been made.

Too often the responsibility for the printing and the maintenance of printed matter is left to a subordinate employee, or is divided between several such employees, none of whom is thoroughly familiar with all branches of the work, when, to obtain the best results, it is almost imperative that the work be under the supervision of an executive with considerable

breadth of view. Such an executive, if familiar with the use of the printed forms, and if possessing a fair knowledge of paper and of printing office routine can, by various means, effect savings that would be out of the question without such knowledge. The importance of assigning to the work an employee having the proper qualifications is self-evident when it is remembered that his duties comprise such features as the standardization of type, papers, etc., designing and preparing forms and other printed matter so as to facilitate the work of the printer and effect the greatest economy to the gas company, the elimination of the use of unnecessary printed matter, deciding upon the quantity to order and to carry in stock, and placing the orders, and settling all questions, with printers. If the executive in charge has the additional attribute of being a systematizer, the work places him in a position to effect much greater savings, for, since printed forms are now used to record practically all of the work of gas companies, they form a natural guide for the simplification, or even the complete elimination, of various kinds of work. Often much work and expense can be saved by showing the needlessness of a form (and the work involved) before the first issue is printed.

It is not feasible in a paper of this kind to cover the ground completely, but an endeavor has been made to give under the following headings sufficient data on which to build an adequate system.

Specifications for Printer:

General:

In preparing copy and specifications for the printer, whether for a new form or for a new edition of one already in use, the object should be to not only make it suitable in every way to the purpose for which it is required, but to also ensure uniformity and standardization, and economy in printing.

The specifications should call for a sample of the paper to be used and two copies of the proof (see "Checking Proofs") and should state clearly the quantity to be placed in each

Form 308.—P. G. W. 10M 6-1-09

The United Gas Improvement Co.,

PHILADELPHIA GAS WORKS.

STREETS INSPECTED BY LINE WALKER.

DISTRICT 190

STREET	FROM	TO

SPECIFICATIONS FOR PRINTER.

FORM NO. *308* QUANTITY *5000*

SIZE: *Same as copy*

COLOR: *Paper-white; printing-black*

STOCK: *Clearwater Bond 17" x 22"--20 lbs*

TYPE: *8 pt. No. 2 Keystone Gothic*

6 - - 2 - -

Type not otherwise specified to be 6 pt. No. 18 Skeleton Lining Gothic

RULING: +*One heavy black printed line*

‡*Light black printed line*

×*Light dotted black lines*

REMARKS: *Pad in lots of 50, deliver in packages of 10 pads each*

Send two copies of proof and sample to.

LINE WALKER.

Fig. 1.—Sample Form showing Specifications for Printer. Page 1711.

wrapped package or box. When the size of the form will permit, card board boxes should be used, for they facilitate the handling of forms, and afford better protection to them after a package has been broken. The cost should be no greater, for the printer saves the expense of wrapping.

It will be found convenient to use a rubber stamp (see Fig. 1) in furnishing specifications to printers. This should be used on the form if it is large enough or, if not, the form should be pasted on, or pinned to, a sheet bearing the impression of the stamp.

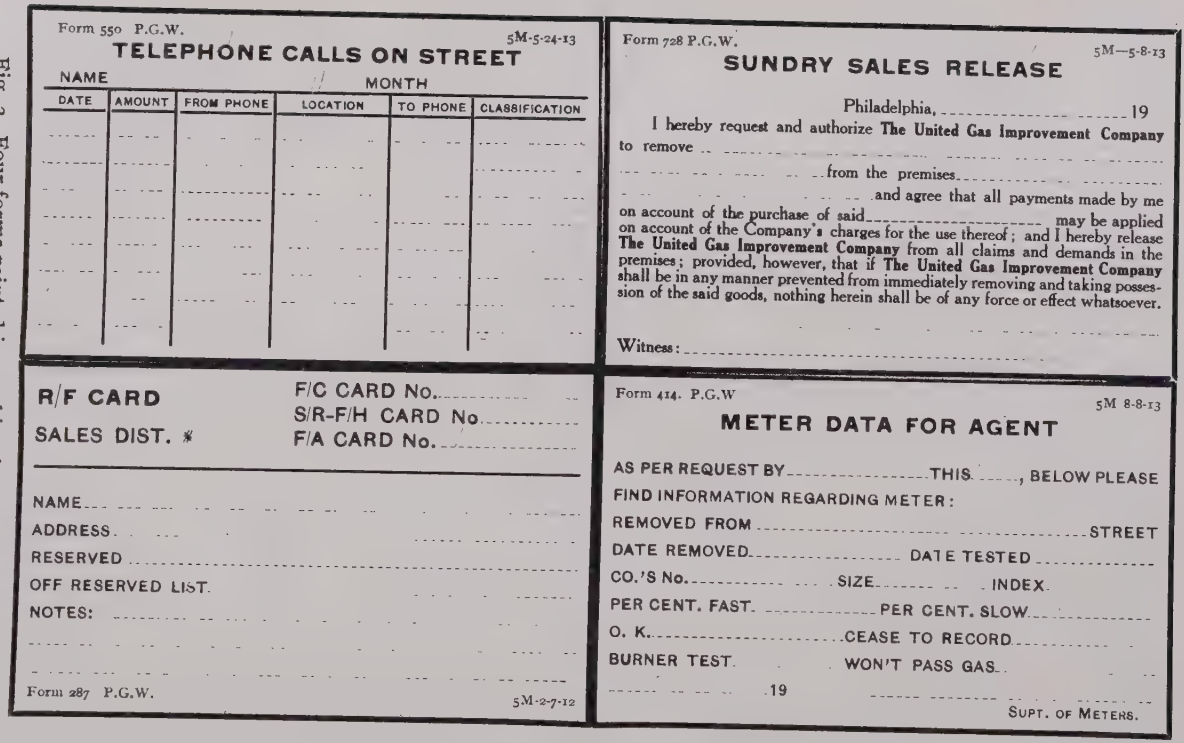
Before designing new forms or ordering a new edition of an existing form, suggestions should be obtained from all qualified sources. In preparing specifications, consideration should be given to the following:

(*a*) Whenever possible, several forms should be printed at the same time on the same kind of paper. By making such combinations, the cost of the press work is greatly reduced, for the printer instead of feeding one form at a time is enabled to lock up the combination and on each impression procure a copy of each form on one sheet of paper, the forms being afterwards separated by cutting and trimming the paper. This is illustrated by Fig. 2, which shows four 3″ x 5″ forms, each issue consisting of 5,000 copies. By printing the four forms at one time on the same kind of paper, cut to a size slightly larger than 6″ x 10″, and feeding at the rate of 1,000 per hour, the press work will take 5 hours instead of 20 hours, as would be the case if each form were fed separately.

(*b*) The ink used should, if possible, be confined to one color, as this reduces the cost of press work. Each color on a form means a separate operation on the press.

(*c*) Scoring, which is cheaper, should be substituted for perforating when there is no particular reason for using the latter.

(*d*) The style and cost of binding should be governed by the use to which the printed matter is to be put. Often an inexpensive binding will answer the purpose just as well as an expensive one. For rule books, price schedules, etc., loose leaf binders are usually preferable, for they permit the reprinting of individual pages from time to time. Forms carried in quantity by workmen should be padded, for this keeps them cleaner and there is less waste than when carried loose.



Form 550 P.G.W. 5M-5-24-13

TELEPHONE CALLS ON STREET

NAME MONTH

DATE	AMOUNT	FROM PHONE	LOCATION	TO PHONE	CLASSIFICATION

Form 728 P.G.W. 5M—5-8-13

SUNDRY SALES RELEASE

Philadelphia, _____ 19

I hereby request and authorize **The United Gas Improvement Company** to remove _____ from the premises _____ and agree that all payments made by me on account of the purchase of said _____ may be applied on account of the Company's charges for the use thereof; and I hereby release **The United Gas Improvement Company** from all claims and demands in the premises; provided, however, that if **The United Gas Improvement Company** shall be in any manner prevented from immediately removing and taking possession of the said goods, nothing herein shall be of any force or effect whatsoever.

Witness: _____

R/F CARD F/C CARD No. _____

SALES DIST. # S/R-F/H CARD No. _____

F/A CARD No. _____

NAME _____

ADDRESS _____

RESERVED _____

OFF RESERVED LIST _____

NOTES: _____

Form 287 P.G.W. 5M-2-7-12

Form 414. P.G.W 5M 8-8-13

METER DATA FOR AGENT

AS PER REQUEST BY _____ THIS _____, BELOW PLEASE FIND INFORMATION REGARDING METER:

REMOVED FROM _____ STREET

DATE REMOVED _____ DATE TESTED _____

CO.'S No. _____ SIZE _____ INDEX _____

PER CENT. FAST _____ PER CENT. SLOW _____

O. K. _____ CEASE TO RECORD _____

BURNER TEST _____ WON'T PASS GAS _____

_____ 19 _____

SUPT. OF METERS.

Fig. 2.—Four forms printed in combination on same kind of paper. Page 1711.

(*e*) The use of colored paper is often a matter of personal whim rather than of necessity. White paper should be used whenever possible, for this greatly simplifies the selection of paper on subsequent orders, as it is frequently difficult to match colored paper. When it is necessary to use colored paper, the various tints should be selected with careful thought as to the effect on the eyes of the reader. This is especially important when the data on the forms are read by a night force.

(*f*) Certain notices to consumers should be printed on postal cards instead of on letter heads, so as to effect a saving in postage.

(*g*) In large situations where the same style of letter head is used by a number of executives, each having his name printed thereon, a large quantity (without the name) should be lithographed and kept in stock by the gas company. When a supply is wanted the required number of blanks should be sent to the printer with an order to imprint the executive's name. This method is more economical than having a small quantity of letter heads lithographed, or printed, complete in small quantities each time an executive requires them.

(*h*) When it does not involve a waste of paper, the printed matter should be confined to one side of the form, for this saves one operation on the press.

(*i*) Whenever possible, the cost of ruling should be reduced by having the lines printed instead of machine ruled, which is usually an expensive operation.

Quantity:

The number of copies of a form to order should be carefully determined. When the form has been in use a long time and, therefore, has proved its value, a year's supply will probably be the most economical quantity, but in this connection the printers' charges must be considered. If less than 1,000 copies are used annually it is usually advisable to order this amount or even more, even though it greatly exceeds a year's supply, for in quantities up to 1,000, the printer's charges vary little and decrease materially for each additional thousand. The number of postal cards, when a large quantity is involved, should be confined to three months' supply.

When there is reason to believe that the use of a new form will suggest changes not otherwise known, and especially if the cost of printing is a large item, then manifestly only a

small edition should be printed, or, better yet, the first issue run off on a mimeographing machine. Experience soon shows in what quantities the best terms can be made with printers, and also what capital it is advisable to tie up in stock.

Size:

The manufacture of standard filing cabinets and the universal use of card records, letter heads and printed forms has had the natural effect of standardizing sizes to a great extent, and experience has shown that with comparatively few exceptions these sizes are adaptable to the requirements of gas companies. Although paper and card board are manufactured in such sizes that forms can be cut to almost any desired size without the question of waste, or the cost of cutting, having any material effect on the expense, it is advisable to standardize the sizes of forms, even when not compelled to do so by filing conditions. Having once decided upon the sizes to be used, and it will be found that only a few sizes will be required for several hundred forms, it is a simple matter in designing a new form to select a size that will be suitable for the amount of printed matter required without crowding or making close illegible writing necessary. Further than this, uniformity in size means neatness, and more convenience in handling, as is evidenced, for instance, when it is necessary to fasten together several different forms, or when storing new or used stock. A gas company having its own printing plant will also find that a smaller stock of paper need be carried when the sizes into which it is to be cut are governed by a standard.

For most card records, a card approximately 3″ x 5″ has proven satisfactory as to size and convenience in handling, and can be used for practically all work orders, schedules, etc., carried by workmen. This uniformity in size enables the workman to carry his orders and other data compactly, and with more cleanliness, in a small holder. When more data than can be entered on a 3″ x 5″ card are required, by using heavy paper, or a very thin card board, the size can be made

5″ x 6″, or 5″ x 9″, which when folded evenly once or twice still remains standard, and can be filed in standard filing cases. Tags should be so made that when the stub is torn off a 3″ x 5″ card remains.

DISTRICT	HOUSE TEST Gradual Cease	DEPT. ORDER No.	Form 554 P.G.W. 15M 5-7-09

LOCATION .....

NAME .....

METER No. ..... SIZE ..... INDEX .....

Movement with large flame in three minutes? .....

Movement with 1½ inch flame in ten minutes? .....

HOUSE TEST MADE BY

.....

Date 190

PROVER DATE	PASSED BY		ERROR		PROVER INDEX
	Meter	Prover	Per Cent. Fast	Per Cent. Slow	
..... 190					.....

Valve will ..... Cut off. Burners Non-Register .....

Valve Leaks ..... Burners. ..... Supt.

Fig. 3.—Form Before Standardization of Type. Page 1716.

Form 554-P.G.W. DISTRICT	ORDER NO.	15M 2-9-14 GRADUAL CEASE HOUSE TEST

C E

LOCATION .....

NAME .....

METER NO. ..... SIZE ..... INDEX .....

MOVEMENT WITH LARGE FLAME IN ..... MINUTES? .....

MOVEMENT WITH 1½ INCH FLAME IN TEN MINUTES? .....

HOUSE TEST MADE BY

.....

DATE 191

PROVER DATE	PASSED BY		ERROR		PROVER INDEX
	METER	PROVER	P. CT. FAST	P. CT. SLOW	
..... 191					.....

BURNERS NON-REGISTER ..... SUPT.

Fig. 4.—Form After Standardization of Type. Page 1716.

Many papers are manufactured and carried in stock in folio or double folio size (17″ x 22″ and 22″ x 34″ respectively) each sheet cutting without waste to the standard letter head size, 8½″ x 11″, which is in general use. By cutting this size in half, a sheet 5½″ x 8½″ is obtained, and by a further division, a sheet 4¼″ x 5½″. These sizes, in conjunction with the standard 3″ x 5″, will be found to answer the purpose in most cases, and, as the paper can be cut without waste, are the most economical. For certain printing, however, it is not practical from the printer's point of view to cut without waste, but such cases must be learned from experience.

Type:

All printing should be in type of such size and character as to be easily legible even to men with defective eyesight. Where space is limited, abbreviations may often be of value in permitting larger type. It will be found advantageous to standardize, as much as possible, the kinds of type used, for this simplifies the work in preparing specifications for printers, insures uniformity and clearness, and reduces the amount of capital invested in the case of private printing plants. Catalogues showing the various type faces can be procured from type supply houses. For form work in general, upper case Gothic, which is a plain, square-cut type, will be found quite satisfactory if used in series, but for solid matter, other styles are usually preferable. This is also true of printed correspondence and certain other matter. The following types when used in appropriate combinations produce quite satisfactory results. Figs. 3 and 4 illustrate the effects obtained by standardization of type, the former showing a form printed with type selected by the printer and the latter the same form with Gothic type. The specifications should state clearly the kind of type to be used. For example, if the American Type Founders Company's type is selected, it should be specified as "Lining Gothic 10 Point No. 520", etc.

LINING GOTHICS

6 Point No. 522

STUPENDOUS EARNINGS REPORTED ON THE RAILROADS
WESTERN TEACHERS RECEIVE UNIVERSAL RECOGNITION
BOUNTIFUL NATURE BESTOWING MANY VALUABLE IDEAS
HEARTY APPETITE REQUIRED AROUND EVERY MEAL TIME

6 Point No. 523

PERSEVERANCE IS ABSOLUTELY INDESPENSABL
PRINTING MATERIAL AT RIGHT PRICES ALWAYS
MANY REMARKABLE MEMOIRS FOUND MONDAY
AMERICAN TYPE FOUNDERS COMPANY STYLES

6 Point No. 524

COMFORTABLE WARM WINTER CLOTHES
MAGNIFICENT BUILDING WAS ERECTED
DESCRIPTIVE $12345678 CIRCULATION

6 Point No. 525

MOVED 2 LUNCH COUNTERS TO-DAY
A FISHERMAN CAUGHT LARGE BASS
COWBOY DELIVERED A LARGE HERD

8 Point No. 526

COMPOSING NEWEST DESIGNS
USEFUL GOTHICS PURCHASED.
SHOWING A DISTINCT QUALITY

10 Point No. 520

EXPLODES LARGEST TORPEDO
TUTORS INSTRUCT STUDENTS

12 Point No. 520

CONSTRUCTS BRIDGES
SPECIMEN DESTROYED

TITLE GOTHIC NO. 7

6 Point No. 73

THE IMPROVED TRANSPORTATION FACILITIES ARE PROMISED VERY SHORTLY
SOME ENTERPRISING MEASURES PLANNED BY AN EXPERIENCED STATESMAN
VERY HUMOROUS QUESTIONS ARE ANSWERED IN A GOOD-NATURED MANNER

6 Point No. 72

HUGE STEAMSHIP IS REMODELED AND SENT EASTWARD
INTERESTING STATEMENT REGARDING AN OLD COMPANY
FINANCIAL GIANTS STARTLE FOREIGN SHIPPING FIRMS

6 Point No. 71

PRINTERS CONTINUALL PICKING LIVE JOBS
MOST REMARKABLE PROFIT-MAKING FACES
PROMINENT PUBLISHERS DESIRE QUALITY

8 Point

NEWSPAPER AND BOOK ADVERTISMENTS
TYPE STYLES GIVE US PROMPT RETURNS

9 Point

THE BEST MATERIAL FOR PRINTERS
THE LINING SYSTEM IS THE PERFECT

10 Point

ALL PRINTERS ADMIRE OUR TYPE
THE MOST DURABLE EVER MADE

Wording and Arrangement:

The wording and arrangement of the matter on a form is often of great importance, and is always worthy of much study. The wording on a form may be of great value in insuring a correct report. For instance, in fitting work where green men are often employed in large numbers at times of peak load, every form used should convey a clear idea of the report desired. The headings, inquiries and remarks should be fully explanatory, yet so concise that ample space is left for filling in the required data. In designing a new form, the first draft will usually follow the order in which the information desired comes to mind. This order usually requires modification in order to provide as far as possible for uniform width of columns, for convenient locations of significant numbers, remarks, etc. Also, any possible standardization of arrangement in connection with forms of similar nature, should be considered. For instance, all meter work orders should have the meter data arranged in the same order. To be of the greatest value, all such standardization of arrangement should be based on the convenience of posting to and from the form. When there is a logical sequence in which certain data are most easily obtained, that sequence should, of course, be used on all forms containing these data.

Proper spacing of the matter on a form is quite essential

to ease in obtaining information from it, especially when the reports are made by workmen using pencils. In such a case every endeavor should be made to leave generous room where the report will be voluminous, and to economize where "Yes" or "No" is apt to be the answer. Also, wider lines are needed than if the form is to be filled in by a good penman, with pen and ink. For office forms to be filled in on the typewriter, no lines should be shown, but the spacing should correspond with the spacing on a typewriter, as this saves the time of the operator. After a new form has been in use for some time, a study of the reports made on it, will generally indicate a number of changes in spacing that can with advantage, be made in the next edition.

An incidental advantage connected with a proper study of spacing is that it naturally leads to the preparation of a neatly drawn scale copy for the use of the printer. Such a copy not only insures more accurate work and saves time in passing proofs, but, by reducing the printer's labor, results in closer bidding on his part.

Close attention to the foregoing details may be productive of much economy. The following specific features, bearing on wording and arrangement are given as a guide to the designer.

(*a*) The form number should appear in small type in the upper left corner of the form, and should be affixed with the initials of the company's name; thus, "Form 49—P. G. W." (Philadelphia Gas Works). However, when it is the practice to embody the name of the company in the title, only the form number need be given. For obvious reasons, it is advisable to assign a number to every form; and this number should not be changed unless the form is made obsolete, or for some other good reason.

(*b*) In the upper right corner should appear in small type the quantity ordered and the date; thus, "5M. 4-1-14." This information is of great convenience in checking waste in usage and in determining the quantity to order for subsequent issues.

(*c*) The title or name of the form should be placed near the upper edge of the form in large clear type, and should be as distinctive as possible, in describing its purpose, and in differen-

tiating it from other forms, especially those similar in character. Above the title belong the names of the company and department in which the form is used, when the custom is to print these designations on the form. On small forms and whenever space is limited, they are probably not justified, but under other conditions, they add to appearance and completeness, but, of course, increase the cost to a small extent. The title should be so arranged that the subject will appear first. Thus, the title "Report of Street Lamp Erections" should be stated, "Street Lamp Erection Report." For periodical reports, the title should show the period covered, as, for instance, "Electric Wagon Daily Report." In the title the terms "Report," "Record" and "Order" should be used in preference to such terms as "Card," "Slip," "Sheet" and "List"; and abbreviations on a form should appear only when made necessary through lack of space.

(*d*) The appearance of a form will be greatly improved by omitting lines from directly under printed matter; thus "Name of Consumer _____" should appear as, "Name of Consumer _____."

Paper:

In order to effect the greatest economy and, at the same time, select stock that will answer all requirements, considerable knowledge of paper is necessary. It is not sufficient to specify that the form should be printed on the same kind of stock as shown by sample, unless the brand and weight of the sample is known, for the tendency of printers is to submit samples a trifle inferior to the paper desired, the difference being hardly discernible except by acute tests. This not only leads to disputes, but, in the absence of careful watchfulness, means that a form can gradually lose in quality from issue to issue until there is a great difference between the first and the latest issue. To avoid these features, and to guarantee uniformity, it is always advisable to specify the brand, size and weight of the paper, and, when possible, to select a paper bearing a water mark, for this affords an additional check when comparing the stock supplied by printers.

Familiarity in the use of the forms will naturally be a guide in deciding how much should be expended for stock, but with-

out standardization and a well defined system for the selection of papers, the best results cannot be obtained.

Possibly as good a method as any for the beginner to follow in the standardization of paper is to procure from several paper supply houses a good variety of samples and the price lists pertaining to them. In this connection the Walden Directory of Papers, published by the Walden-Ris Company, New York City, which gives for all cities the prices of water marked papers, and the names and addresses of the supply houses carrying them, will be found of great value. A careful comparison of papers and prices will show that only a few brands of paper are required for several hundred forms, and that, in many cases, existing forms can be printed on paper costing less, but apparently being equal in quality to that already being used. Experience soon makes it possible to tell from touch alone the quality and, very closely, the price of papers. For the selection of papers, the beginner should make a study of the methods used in obtaining paper of the same weight in various sizes, and in determining the quantity to order and the best paper to use in regard to size and price. As a guide to the former, the comparative weights of papers as shown in the tables in the price lists will be found of great value. There are several short methods that can be used in calculating the amount of stock required, the best size to cut from and the cost. For example, if 10,000 copies of a form 5½″ x 8½″ are desired, it will be found from the following calculation that a sheet 17″ x 22″ will cut without waste, while a sheet 18″ x 23″ will cut to waste.

$$\frac{\overset{2}{17}'' \times \overset{4}{22}''}{5\tfrac{1}{2} \times 8\tfrac{1}{2}} = 2 \times 4, \text{ or 8 out without waste.}$$

$$\frac{\overset{2}{18}'' \times \overset{4}{23}''}{5\tfrac{1}{2} \times 8\tfrac{1}{2}} = 2 \times 4, \text{ or 8 out with one inch waste on each side.}$$

Continuing this example, if paper weighing 24 lbs. to the

ream (usually 500 sheets) and costing 12 cents per lb. is selected, it will be found that 1,250 sheets (10,000 ÷ 8) or 2½ reams will be required, and that the cost will be $7.20 [2½ (reams) x 24 (lbs.) x 12 cents]. The cost can also be quickly determined in the following way:

$$\frac{\overset{20}{\cancel{10{,}000}}}{\underset{1}{\cancel{500}}} \times \frac{\overset{5}{\cancel{5\frac{1}{2}}}}{\underset{2}{\cancel{17}}} \times \frac{\overset{8}{\cancel{8\frac{1}{2}}}}{\underset{4}{\cancel{22}}} \times \frac{\overset{12}{\cancel{24}}}{1} \times \frac{\overset{3}{\cancel{12}}}{1} = \$7.20, \text{ cost of paper.}$$

In selecting papers, and preparing specifications for printers, the work will be greatly facilitated by compiling a file of samples of papers. Each sample should have entered on it the brand, size of sheet, weight per ream, price, and where obtainable; and all samples of the same price should be filed in one folder. In standardizing, and in checking samples of papers furnished by printers, this file will be found of great value.

Electrotypes:

In order to print several copies of a form, or other printed matter, on each impression, and thus save press work, and also, in the case of long runs, to save wear and tear on the type, printers frequently have electrotypes made. Unless arrangement are made to procure these electrotypes when the job is finished, they are retained by the printer with the expectation that he might be asked at some future time to bid on the same job, in which case he will be saved the cost of composition and electrotypes and can possibly under-bid other printers. However, in the absence of a bid from the printer holding the electrotypes, the gas company is usually put to the expense of having another set of electrotypes made by another printer when the next edition is printed. For the majority of forms that remain the same, or to which only slight changes are made from time to time, it usually pays to have electrotypes made, whether the printer would have done so or not, and to purchase them from the printer. The cost is small in comparison with the saving that can be effected on subsequent orders by

the elimination of the cost of composition. In addition to this, no one printer can control prices by having the advantage over other printers due to his having possession of the electrotypes.

While the skillful purchasing of electrotypes can be made a very profitable feature in printing, it requires a thorough knowledge of the use of the forms concerned, and also considerable familiarity with the printing business in general, for without this, losses can easily be incurred. When there is any doubt, the safest plan is to discuss the matter thoroughly with the printer when placing the order. The remarks under this heading apply also to halftones, linecuts, etc.

Placing Orders With Printers:

In situations where it is possible to do so, it is, no doubt, advisable to make the executive in charge of the work described in the foregoing pages, responsible for the placing of orders with printers, for his familiarity with all details places him in a better position to make terms than would be the case if the orders were placed by an executive whose duties in connection with printing were confined simply to making terms with printers. When the placing of orders is only a small part of the duties of such an executive it is not always feasible for him to specialize on printing, and his work in this respect often consists only in procuring the lowest bid; whereas, with a good knowledge of the use of the forms he is ordering, and with printing office practice, he might effect material savings. Such features as procuring electrotypes, substitution of papers, and increasing the quantity called for by the order, when this can be done with only a slight increase in cost, are items that are difficult to adjust, unless in close touch with the work.

In placing orders, one of the best methods to follow, especially when unfamiliar with what the jobs should cost, is to obtain competitive bids from several printers, and, other things being equal, to give the work to the lowest bidder; but this practice without the exercise of good judgment can easily be

overdone, for where the expense involved is small, the time consumed in interviewing printers and the delay in getting the job started might more than offset the gain. Except for the larger jobs, satisfactory results should always be obtained by estimating the cost of the work in the same way that a printer would do, allowing for a fair profit to the printer, and then placing the order with a reliable concern at approximately the price shown by the estimate. Even for large jobs for which competitive bids are obtained, it is a wise precaution to determine as near as possible what the actual cost will be, so that in the event of the first bids being too high, the bidding can be continued until a satisfactory price is offered. In competitive bidding, it is not well to confine the work to certain printers, for they soon learn to adjust their bids to meet those of other printers. A printer who continually loses in competition with others will lower his terms, while one who is frequently successful will realize that he is underbidding other printers, and will likely adjust his charges accordingly. Often attractive prices can be obtained by giving the work to printers located in small nearby towns, where the cost of operating printing offices is not so great as in large cities; and also by giving certain classes of work, such as forms that are used continually, out by yearly or semi-yearly contract. Except for rush orders, single jobs, unless very large, should not be given to printers to estimate on, for this wastes the time of all persons concerned, and is apt to result in higher prices being charged than if a large order is given, especially if the printer is able to save expense by working several of the jobs in combination, as is often the case when the same kind of paper is used, and when the ruling, binding, etc., are identical. When the quantity to be carried in stock has been properly regulated, it is a simple matter to check the stock periodically, say once a week, so that a suitable order can be prepared for the printer.

Printers usually add a generous percentage to the cost of paper, and as it is generally bought in small quantities for

each job, the highest price is paid. By purchasing paper and giving the work out for printing only, gas companies can save the profit added by the printer and, where the use of paper has been standardized, can effect a further saving by buying paper in large quantities at a much lower rate than printers pay for small consignments.

As a guide in placing orders for printed matter that is ordered from time to time without any changes, or with very slight alterations, it is well to keep a record (as shown in Fig. 5) showing the prices paid for previous editions. The value of such a record is obvious.

PRINTING COST RECORD

NUMBER..... NAME.....

DATE ORDERED	QUANTITY	COST	NAME OF PRINTER

Fig. 5.—Cost Guide for Purchasing Agent. Page 1725.

Checking Proofs:

It is always advisable to receive from the printer two copies of each proof (one to be checked and returned and one to be kept for reference) and a sample of paper sufficient in size to permit part to be returned to the printer and part to be kept for comparison with the printed matter when received from the printer.

While an order is in the hands of the printer, it is well to keep a history record of it. This record should show the name of the printer, the date order was placed, the date proof

and sample of paper was approved or rejected, etc. To this record, should be attached the copy of proof and sample of paper.

In checking proofs, red ink should be used, and the corrections should be plainly marked. When a large number of errors are found in a proof, it sometimes indicates that the printer is either depending entirely upon the purchaser for proof reading, or is paying very little attention to it; thus the person checking the proof is compelled to do work that really belongs to the printer, and the matter should, therefore, be taken up with him. As a rule, it is fair to expect that the proof, barring author's changes, should be correct when received.

While printers are accustomed to making changes from corrections designated in various odd ways, it is an easy matter to use the symbols with which they are familiar, and by doing so, time will be saved and misunderstandings forestalled. The symbols shown below should be placed in the margin of the proof, as indicated in the example.

SYMBOLS.

∧ = Insertion to be made.

¶ = New paragraph.

⊙ = Period.

"/ = Quotation mark.

'/ = Apostrophe.

/—/ = Dash.

/-/ = Hyphen.

,/ = Comma.

;/ = Semi-colon.

:/ = Colon.

δ = Cancellation of data, or a change in manuscript. (To cancel data, a horizontal line should be run through it and a dele (δ) placed in the margin. When a change in manuscript is desired, the data to be inserted may be either written above, or in the margin.)

Cap. = Capitalize. (Three lines should be placed under the letter to be capitalized.)

Tr. = Transposition of words. (A line should be drawn under the first and over the second word.)

l. c. = Change capital to a small letter. (An oblique line should be run through the letter to be changed.)

No ¶ = Unite paragraphs. (A line should be drawn from the last word of the first paragraph to the first word of the second paragraph.)

stet. = Restore data that has been cancelled. (A dotted line should be placed under the words to be restored.)

The omission of a word or letter should be indicated by an oblique line placed in the margin with the word or letter omitted to the left of the line. When there are a number of words omitted, they may be either written above or in the margin.

EXAMPLE.

δ "Under this heading will be described ~~will be described~~ such rules as apply equally to all

appliance / , / classes of fuel∧work∧and in the case of inde-

/ - / pendent connections, to illuminating appli∧

ance work as well.

No ¶ In general the rules referring to the installa-

tion of appliances come first, and are followed

a / l.c. by those relting to complaint Work on appli-

⊙ ¶ *d tr.* / ances∧ ¶ The conditions under charges which

stet. Cap. ⊙ are made are given ~~in detail~~ in form 366"

MAINTENANCE:

General:

Upon receipt of the finished work from the printer, it should, of course, before passing the bill and placing the

goods in stock, be checked for quality of paper, workmanship and quantity. The paper used and the printed data should be carefully compared with the sample of paper and the copy of proof submitted. When a combination weighing and counting scale for quickly showing the quantity of fittings, etc., in various containers is a part of the store room equipment, time can be saved by using it in checking printed matter when received in large quantities. By placing, say 50 copies of a form in the pocket on the scale, and making a simple adjustment, the number of copies in the shipment will be immediately shown by placing the entire consignment on the platform of the scale. While the quantity indicated is not always absolutely correct, it is so nearly so that further checking is unnecessary.

Printed matter should be stored in clean, dry closets having compartments large enough to make it unnecessary to have the stock of the same form scattered, as this might result in ordering another supply before the last is entirely used. The closets should be numbered and should bear a card showing the form number, and indicating that an order for a new supply should be placed when the stock is reduced to a given quantity. Another safe method to prevent the stock from becoming entirely exhausted is to wrap, say, six weeks supply in paper of a certain color, and to order when it is necessary to use the contents of the package, it being understood that the package is to remain intact until the remainder of the stock is used. The length of time to allow for ordering will depend upon the value of the form and upon local conditions, but, in general, ample allowance should be made for delay, because an order which must be hurried is a source of great expense and annoyance to both purchaser and printer. When a form is used by several offices, they should be limited to a supply that will last for a specified time. This is to save waste and prevent overstocking, which might occur if the main stock is exhausted by allowing the various departments to carry an unlimited supply.

Numerical Card Record:

A card record of each form, as shown in Fig. 6, will be found valuable in the maintenance of forms. The data shown in the figure indicate the uses to which the record can be adapted.

Scrap Book or Folder:

A complete set of forms arranged numerically, either in a loose-leaf scrap book, or in folders similar to those used for filing letters, and an alphabetical card index of titles with the corresponding form numbers should be kept for reference. The use of the folder is undoubtedly preferable to the scrap book for it saves time, permits the lifting of the forms, etc. As new editions of forms are printed, a copy of each should be placed in the scrap book or the folder with any previous editions of the same form, when not identical with the latest edition. In this way there will be an historical record showing the development of each form. In the folder can also be placed a memorandum of any changes that might be suggested to a form, and these should be referred to when placing a subsequent order for the form. All departments should be encouraged to submit suggestions for changes as they come to mind, for this saves delay at the time the order is being prepared for the printer. When any form becomes obsolete, the entire set of copies of the form should be transferred to a file of obsolete forms.

Disposition of Forms:

This subject covers the disposition of unused obsolete forms and forms upon which records have been made. In the former case, as forms become obsolete they should either be scrapped or used for scratch pads. When the quantities are large, it pays to send the forms to a bindery for cutting and padding. This work can be easily done by gas companies at a very low cost, by purchasing a small paper cutter and a padding machine. The former should not cost more than $40.00 and the latter not more than $3.50. When a private printing plant

Form 349-P.G.W. 5C. 6-13-12

FORM RECORD

FORM NUMBER_____ ORIGINATED BY_____ ORDERED BY_____

NAME_____ REPLACES_____ MINIMUM STOCK_____

CLOSET NUMBER_____

DATE	QUANTITY	P. A. Order	NAME OF PRINTER	RECEIVED		PRICE	ACCOUNT
				DATE	QUANTITY		

Fig. 6.—Card Record for Forms. Page 1729.

is operated, obsolete forms can often be cut and used for printing, thus saving the purchase of paper. Unused postal cards, even though printed upon, can be redeemed at any post office. Each day witnesses an accumulation of used forms of varying degrees of value. Not only in gas companies, but in the world in general, the important is lost sight of by being buried under the trivial. Instead of preserving every record until such time as lack of storage space forces a possibly ill-considered disposition of a certain percentage, there should be a carefully thought-out schedule covering the length of time each record should be kept. In this way, matter of no value is continually being disposed of, making easier access to important records, for no matter how thorough may be the method of filing, it is true, especially of correspondence, that the smaller the residue kept, the quicker it can be located. The disposition schedule may be kept, either as a card record or on sheets arranged numerically according to form numbers, and in cases where the use of the forms is explained in manuals can, to advantage, contain an index showing where each form is mentioned.

Miscellaneous:

When only a small quantity of a form, or other printed matter, is wanted, the printing can be done most economically by using a mimeographing machine. With a rotary machine, there is no excuse for poor work, providing the stencils are carefully cut, and the operator of the machine is careful. When it is not possible to cut the stencil on a typewriter, it should be done with a style by a competent draughtsman. For a form that is mimeographed from time to time, it is advisable to use the dermatype stencil, for after a run is finished, the stencils can be set aside and used again for subsequent issues. For certain forms, when very small quantities are used, a rubber stamp can be used to advantage. This is also the case for addressing envelopes for intra- and inter-departmental use. When the amount of mimeographing and stamping is large, it is advisable to centralize the work, and to

make one person responsible for it, for this means less equipment, and better and lower priced work.

For inter-departmental correspondence, a material saving can be effected by using a printed instead of an engraved or lithographed letter head. This should be in two sizes, one for short and one for lengthy correspondence. Carbon papers in the same sizes should be used.

Some printers in delivering printed matter make a practice of pasting a copy of the form on the outside of each package as a means of identification. On large orders, or when the form is costly, this practice is wasteful and should be overcome by asking printers to chalk the number of the form on the outside of the package.

Private Printing Plants:

While the writer has had no practical experience in the operation of a private printing plant, the remarks that follow, and which are virtually a recommendation that experiments be made along this line, are advanced only after an exhaustive investigation covering the subject in detail, and on the confirmation of printers, paper dealers and craftsmen in the allied trades that the proposition is feasible and practicable, and is already being successfully followed by many concerns.

The equipment required for a private printing plant is comparatively inexpensive, so there should not be the same hesitation on the part of gas companies to venture into this side line as there might be, for instance, into the manufacture of meters, or fuel appliances. Further than this, practically all of the printing for a gas company is of a class not requiring highly skilled, and therefore, highly paid, labor, and can be supervised without the difficulties usually encountered when attempting to work a side line in conjunction with another business. In considering the subject, it seems logical to reason that the feasibility of the proposition is the only feature requiring especial attention, for it is indisputable that a private printing plant managed as economically as those of outside printers must necessarily save at least the profit now paid to

printers. As a matter of fact, the saving should be greater than this profit, for the overhead charges would be much less. For instance, the operation of a private printing plant does not involve soliciting trade, collection of bills, losses due to delinquent accounts, etc. To the direct saving in the cost of the printing should be added the saving effected by the reduction of work in the purchasing agent's office by the elimination of interviews with printers and dealings with the departments ordering the work; by time saved in checking and counting printed matter received for stock, and in passing bills, as the former work is unnecessary, and the latter greatly reduced in the case of a private printing plant; and by being able to keep the quantity of stock at a minimum, thus reducing the interest on the investment. The matter in the foregoing pages will suggest many features that can be made to return a profit in the operation of a private printing plant, as, for instance, the control of electrotypes, the purchase of paper, the use of obsolete forms for printed matter, etc.

The labor and equipment required for the operation of a private printing plant will, of course, depend upon the amount of printing, but in any event, it is advisable to start in a small way. For most situations, the start should be made with a one-man plant, the equipment for which is listed below. In selecting a printer, it is well to take one from a small town, where the workmen in a printing office are accustomed to doing all varieties of printing work, from feeding presses to composing. It is not difficult to procure the services of a printer who is willing and capable of performing all the practical duties required in a one-man plant, for the assurance of a permanent position with fair wages and no lost time makes the position attractive; nor is it necessary to select a man who is capable of taking full charge of the printing work, for if the specifications are prepared, and the papers selected by an executive, as described in the foregoing routine for printing work given out by a purchasing agent, the qualifications of the printer can be confined to his practical experience, and his duties to productive work only, thereby keeping the over-

JOB RECORD

.....191

WORKMAN'S NAME .....

FORM NUMBER ..... QUANTITY .....

	TIME	
	STARTED	FINISHED
CUTTING PAPER BEFORE PRINTING		
CUTTING PAPER AFTER PRINTING		
COMPOSITION		
DISTRIBUTION OF TYPE		
LOCK-UP AND MAKE-READY		
PRESS WORK		
PADDING		
FOLDING		
PREPARING FORMS FOR SHIPMENT		
MISCELLANEOUS		

COST DATA

LABOR	$
STOCK	
ELECTROTYPES	
RULING	
PUNCHING	
PERFORATING	
BINDING	
MISCELLANEOUS	
TOTAL	$

Fig. 7.—Job Cost Record. Page 1735.

head charges at a minimum. By the use of a "Job Record" similar to that shown in Fig. 7, little time need be spent in supervising the actual operation of the plant, for the executive, by an examination of the finished work and the cost details, will have sufficient knowledge of it. When only one man is employed, the cost of the simpler work (feeding presses, padding, etc.) is much higher than is the case in regular printing offices, where the work is specialized and paid for according to its value. Therefore, when there is sufficient work, it is advisable to employ a helper. This need be only a large-sized boy or a young woman.

When only one man is employed, it is not really necessary to have an 8" x 12" press, although it is more economical to do so, as the smaller press has greater speed and is more suitable for certain classes of work. If the 8" x 12" press is not desired, the cost of equipment can be reduced to the extent of $203.00 by omitting the items marked "x".

PRINTING OFFICE EQUIPMENT.

Machinery:			
1	12 x 18 Chandler & Price Job Press, New Series	$260.00	
x 1	8 x 12 Chandler & Price Job Press, New Series	145.00	
1	Fountain for 12 x 18 Press	20.00	
x 1	Fountain for 8 x 12 Press	12.00	
1	½ H. P. Direct Current Sprague Motor	49.60	
x 1	¼ H. P. Direct Current Sprague Motor	43.00	
1	Press Pulley	2.75	
x 1	Press Pulley	3.50	
1	26" Oswega Lever Paper Cutter	130.00	$665.85
Type, etc.:			
5	Lbs. 6 pt. Spaces and Quads	3.57	
5	Lbs. 8 pt. Spaces and Quads	2.90	
1	Font 10 pt. Spaces and Quads	.75	
1	Font 12 pt. Spaces and Quads	.65	
1	Font 18 pt. Spaces and Quads	1.00	
1	Font 24 pt. Spaces and Quads	1.00	
5	Lbs. 2 pt. Labor Saving Brass Rule No. 1002	7.25	
10	Lbs. 2 pt. Labor Saving Leads	2.00	
10	Lbs. 6 pt. Labor Saving Slugs	2.00	
	Supply of Type	160.00	181.12

Wood Furniture:			
1	Square Leg Imposing Frame and Stone 36″ x 48″	25.00	
1	New Departure Cabinet equipped with 5 Triple and 20 California Job Cases	38.75	
1	Midget Font No. 10 Labor Saving Wood Furniture, 10 to 60 Pieces, complete with case	6.00	69.75
Miscellaneous:			
1	Nickle Plated Star Composing Stick 10″ x 2¼″	3.00	
1	Quart Benzine Can	.85	
1	Oval Back Benzine Brush	.40	
1	Hickory Mallet 3½″ x 6″	.40	
1	Maple Planer 3¼″ x 8″	.40	
1	Compact Rule Case	.90	
1	Lead and Slug Case	1.00	
1	12 x 18 All-brass Job Galley	4.00	
25	Lbs. L. S. Improved Metal Furniture	7.50	
1	Doz. Pairs Challenge Hempel Quoins No. 1	1.00	
1	Key for No. 1 Quoins	.38	19.83
			*$936.55

*$900.00 after deducting discount.

In small situations, as an accessory to the equipment mentioned above, and in any case where there are large editions of forms, circular letters, postal card notices, etc., printed in typewriter type (pica, elite, etc.), the Multigraph shown in Fig. 8 should, according to the investigations of the writer, prove a money saver. The machine is equipped with a semi-automatic typesetting and distributing device with a supply of type, but can also be used for a large variety of printing from electrotypes. It will print a form any size up to 8½″ x 12″, providing the actual type surface does not exceed 7½ x 11½″, and will operate at two or three times the speed of a small printing press, according to the kind of work being fed. However, this speed can be met by the larger printing presses by printing a number of copies on each impression. The Multigraph takes up about the same space as a typewriter and desk, and can be operated by a young man or woman having

no experience in the printing trade. In small situations where the quantity of work does not warrant installing regular printing office equipment, the Multigraph can, no doubt, be used to advantage for much of the work, but the saving where electrotypes are required will be reduced, because the composition must be done by an outside printer at a high rate. This also

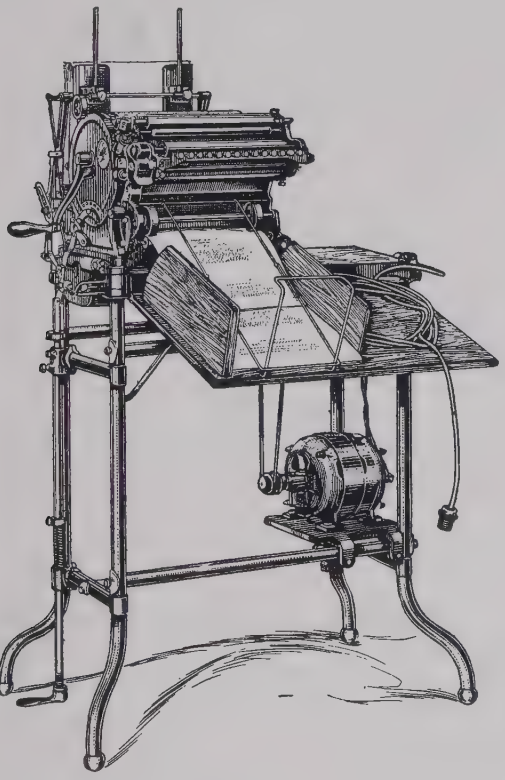


Fig. 8.—Multigraph printing press. Page 1736.

applies to padding and to paper cutting, unless machines are installed for this work. However, a saving of from 27 per cent. to 50 per cent. in printers' bills is claimed by gas companies and other concerns using the Multigraph.

The Multigraph is composed of units, each having its own

function, and can be purchased either complete or in parts. Therefore, a careful study of the requirements should be made when a purchase is contemplated. The machine complete, which includes everything necessary for multiple typewriting and office printing, and also an automatic feed, costs $545.00. If required as an accessory to regular printing equipment, for office printing from electrotypes only, when the feeding is to be done by hand, the parts required cost $345.00.

In purchasing it should be remembered that a printing press, the life of which is no doubt longer, will do classes of work not possible on the Multigraph, and that the cost of electrotypes is much less; but on the other hand, the Multigraph is easily operated and does not require the employment of skilled labor.

When, in small situations, the cost of the Multigraph is prohibitive, good results can be obtained for form work by using electrotypes on an 8″ x 12″ printing press. The employment of a compositor would not be necessary, as this work could be done by outside printers in the same way as for the Multigraph, thus making it possible to employ only a job press feeder, capable of locking up and making ready the work for the press. The wages paid such workmen are moderate.

(Mr. Baylie read an abstract of his paper and made the following remarks:)

Mr. Baylie: I would like to hear especially about private printing plants, if anybody has had experience. When I wrote this paper, I had not had any experience myself, but we have installed a multigraph in the last two or three months, and with that machine, we have had very good results. We have made a saving of something over 25 per cent. on the printing we have done on it, and we expect to do better than that when we get more familiar with the machine. (Applause.)

Mr. O. F. Potter (Newark): Mr. Chairman, I would like to answer Mr. Baylie's question by asking him one: As to the use of the multigraph and its flexibility, what results has he obtained, if his experience with the multigraph installed

was with a single unit or more than one machine? How did he arrange to supply the demand for copies from the machine, or was there delay in delivering finished work?

My experience with the multigraph has been that we have been unable to get work completed just as quickly as we would wish, probably through the lack of equipment. The demand, due probably to the popularity of that form of printing, being great, there was necessarily some delay in having the type set up and the copies run off.

I am not able to give any figures as to what the saving has been, but I know that mechanically, the results have been exceedingly satisfactory.

In connection with the stationery, I would like to know if, in Mr. Baylie's company, the storekeeper issues the requisition for necessary supplies. It is customary in the company with which I am identified for the storekeeper to issue the requisition on the purchasing agent for stationery supplies. This requisition bears details as suggested in Mr. Baylie's paper, and which appears upon The United Gas Improvement Company's form of requisition; but, in addition, our form, in the case of an order to replenish the supply of regular forms, shows the stock on hand at that time and also the amount that has been issued during the previous six months. I think that this information is quite essential, particularly so as in our organization this requisition must be approved by an executive before an order is issued by the purchasing agent. In approving the requisition, it is necessary for him to know how fast the stock moves, and the date of delivery, to intelligently pass upon the quantity ordered.

Mr. H. W. Peck (Schenectady, N. Y.): There is just one point I would like to bring out in this connection, which has influenced us quite largely in placing our orders for printed work. In the first place, being a combination company, we supply both gas and electricity to all of the printers in town, and we rather feel that it is wise to patronize home industry, not entering into competition with them ourselves by estab-

lishing a private plant, although we have considered it somewhat; and also not going outside the city, even though there might be a slight saving. We look into it, and on special work, we do have to go out sometimes, but in general, for the slight saving which might be effected, we prefer to patronize our customers.

There is one other point I would like to mention, too, that we have improved our forms very materially in the last year or two by having every desired change in a form sent as soon as thought of, to the purchasing agent, and to the storekeeper, who also takes care of the stock. Otherwise, the storekeeper is liable to put in a repeat order for a form as soon as the stock gets low. If, in looking over a form while handling it, I notice an improvement, no matter how slight, which might be made, I jot it down, and send the changed form right away to the storekeeper, even though the form may have been purchased the day before. Before the renewal order is placed, the storekeeper observes whether there are any such suggestions in his file, and if so, makes the change, and sends the order through.

Mr. Potter: Mr. Chairman, I wish to rise once again to discuss the question as to standardization of paper referred to by Mr. Baylie. The company with which I am connected has recently given this subject considerable study in an endeavor to standardize our use of paper. The result has been that we have found that there are about 2,700 different water-marked papers obtainable, and among all these, we have found but twelve different grades. We have decided to use six different grades of bond paper, confining ourselves to three different water-marks in each grade. The grades and water-marks are chosen with a view to giving a sufficient variety of choice as to surface, texture and color, so that a desire to use a colored paper would not interfere with our plan, nor would the user of the paper be hampered by the plan. We find it has worked out very satisfactorily, both as to cost and efficiency.

Mr. Ervin Calhoun (Philadelphia): In Philadelphia,

printed matter is handled on a large scale, and we follow precisely the details outlined in this paper (which I consider a very able presentation of the subject), excepting that we have not organized a complete printing plant.

We determine the time to order by a minimum stock record. The minimum quantity to be carried in stock is posted on the card history record for the guidance of the stationery clerk, and it is also shown on the bin label where the stock is stored, so that the order-man should be at all times familiar with the low stock condition.

In ordering printed matter, we find it very essential to state clearly what is wanted, leaving nothing to be inferred. Otherwise, the printer will have the opportunity to take advantage of any loophole in his favor by substituting lighter weight of paper, wrong type, etc. We never fail to stipulate two copies of proof and samples of paper to be submitted before going ahead with completion of order.

From the storeroom standpoint, checking receipt of forms for grade and weight of paper, character of workmanship, and quantity, should be done without fear or favor, and the storekeeper should, in all cases, insist upon the completed work being as per specifications, irrespective of any other consideration, because any such concession leads to greater evils, the worst of which being that certain printers may be enabled to underbid those who endeavor to furnish first-class work. By taking a firm stand in rejecting imperfect material, the storekeeper will materially assist the purchasing agent in ultimately eliminating any unreliable bidders, but I am inclined to agree with Mr. Baylie that it would be advisable to have the responsibility for placing orders in the hands of a specialist, especially in large situations, as, should the rule of giving the work to the lowest bidder always be followed, you will invite the experience of delayed deliveries, material furnished before submitting proof and found to be wrong in some particulars, careless padding, insecure wrapping, etc.

Mr. H. C. Schaper (Milwaukee): When I first read Mr.

Baylie's paper, I was interested in that part of it where he advocates the purchasing of your own paper and supplying it to the printer. To satisfy myself how we would come out on that, I picked out six of our recent large printing orders, went to the printers and asked them to show me their job tickets. The purpose of this was to get the percentage of paper to the percentage of labor cost on the job. I found that 37 per cent. of the cost was for material, and 63 per cent. for labor. Our total printing bills for 1913 amounted to $5,073, so that the value of the paper stock used was approximately $1,877. I ascertained that the customary charge which a printer makes, as Mr. Baylie calls it "profit" on the paper (the printer claims that is his cost for handling), the customary charge is approximately 10 per cent.; it varies from 5 to 15; I should say 10 per cent., but the printer assured me that such a charge would be made whether they furnished the paper or whether we furnished it; the cost of handling is the same. So that you save nothing of that "profit" of which Mr. Baylie speaks.

It is true that if you standardize your kinds of paper, you can buy it in ream lots, and on small orders, the printer would have to go out and buy in broken ream lots and pay the broken ream price. I found out that the difference in cost between broken ream prices and ream lots is about 20 per cent. Assuming that all of our orders were for broken ream lots (which they were not), it would have effected a saving, if we had bought the paper, of 20 per cent. on $1,877, or $375.40.

It is a fact, however, that a good many of our orders were for quantities which required more than ream lots, so that if I were to assume that one-half of our orders were for broken ream lots, we would have effected a saving on the paper of approximately $185 had we supplied it to the printer. Now out of that $185, however, has got to come our cost of handling; and I wonder whether we would be any money ahead trying to handle our paper for a year for $185? I think not. Of course, that applies to our company; in very large concerns, the conditions may be very different.

There was one other thing that struck me, and that was the purchasing of electrotypes. It had never occurred to me before that it was possible to buy electrotypes, and on a recent order, I requested our purchasing agent to ascertain what the cost of the electro would be after the job was finished, and he got the reply from the printer that he would not sell the electro under any circumstances. We then sent to another large printing house who does a lot of work for us, and their answer was the same, and the reason they put forth was that they would not sell the skill of their compositors and allow competitors to bid with them on work that they had in fact created.

THE CHAIRMAN: We would be glad to hear from Mr. Baylie in answer to some questions that have been asked here.

MR. BAYLIE: There has been delay in our multigraph printing, but that was due to a cause that will disappear after we become more familiar with the multigraph. As a matter of fact, we had broken one young man in to operate the machine, and he was doing the work nicely, when he left, and we had to break in another. The second attempt was with a 16-year old boy, and on account of his age and the low wages paid, we were satisfied to wait patiently for results. We did not want to give to the printers the orders that were accumulating, because we could save money by printing the forms ourselves, so we held them up and that caused delay.

Long before we started to do our printing, we had an arrangement to offset the delay caused by printers. As we found that printers are apt to hold up the work anywhere from two weeks to two months, our stock of all forms is so regulated that the stationery storekeeper places an order when the stock of any form is reduced to two months' supply. This method will give us ample time to get the work out on the multigraph.

When a rush order comes in, we can get it out very rapidly on the multigraph, especially if we set the type ourselves. In actual practice, we have received rush orders one day and had the printing done and delivered the next day. If we have an

electrotype made, it might cause one or two days' delay. I don't think the delay is a feature that we need consider at all. When we get the machine started, it prints so rapidly that I don't think a printer can ordinarily meet the speed. I recall one job for which we were in a hurry. We ran the machine for eight hours, and turned out 24,000 copies at a cost of $1.00 for press work.

Our stationery storekeeper does prepare the order, but before it is placed with the printer, or before our private plant does the printing, it is checked by an executive, who understands the company's general system pretty thoroughly, and he not only checks it for printing details, but to see if its use can be eliminated entirely. Some of the data given by the stationery storekeeper we found, since starting to do our printing, is not of much value; for instance, in regard to quantity. The other day we received an order to print 1,500 copies of a form. This required three-quarters of a ream of paper, and the quantity was 50 per cent. more than we would ordinarily order. When we figured the cost of printing, instead of gaining by reducing the order, or by leaving it 1,500, we found that we could buy a full ream and print 2,000 cheaper than by paying an additional price for a broken ream of paper in order to print fewer. Such points as these you have to consider, for no two orders seem to be alike, and the data furnished by the stationery storekeeper should be taken only as a general guide.

Lithographing work I do not know much about, but I think that we do, through our purchasing department, have much of our work done in this way. Whenever the run is long enough, and the form can be lithographed, I believe that is the cheapest way to do it.

One way to overcome the annoyances of having printers refuse to give up electrotypes is to make their return a part of the agreement when an order for printing is given. Printers would not make electrotypes if it were not to their own advantage, either to save wear and tear on their type, or in order to

print several copies on each impression. They include the cost of the electrotypes when bidding, or when billing, and they should not hesitate to turn them over to the purchaser when the job is finished. The only advantage the printer has in keeping them, as we see it, is to be able to underbid other printers on subsequent orders. In Philadelphia, we have several concerns which set type and make electrotypes. This enables us to give the printing to whom we please, for in this way, we can control the making and ownership of electrotypes.

Mr. Walton Forstall (Philadelphia): I was extremely pleased by some things Mr. Schaper said. For years I have constantly urged the advance publication of papers. Mr. Baylie's paper was published fairly early; it was read in Milwaukee. Mr. Schaper's company benefited from it right off, and now he comes back and tells us how it has been benefited. It is a very nice thing to see that fact so prominently brought out. He applies the paper to his local situation, and he comes here to tell us of the lessons so derived from the local situation, so we get a double value from the paper by its early presentation.

I have always been very much interested in the subject of forms, and I have been fortunate enough in having experience with them, both in a small and in a large company. I have always tried to keep before me the idea that although forms had no reason for existence, except as an aid in economical operation, yet in a large situation they might become a source of waste; consequently, the endeavor has always been, after thorough consideration, to originate no form which could not justify its existence, and to continue in use no form which seemed to have outlived its usefulness. The system described by the author is that followed in the Distribution Department of the Philadelphia Gas Works, and while our organization was in process of development, we used to great advantage the weekly meetings of our district superintendents in discussing many details relating to forms.

What is said with reference to wording and arrangement,

might seem unnecessary, if each day we did not see striking examples of the disregard of the principles there laid down. As the author says, the study of a new form, after it has been in use some time, is very important in deciding upon what changes, if any, should be made in the next edition. Also, as to paper; only those who have gone into this subject carefully can appreciate the lack of standardization usually obtaining and the possible savings by never purchasing any better quality of paper than is required. The intelligent use of electrotypes will furnish another link in the chain of economies possible to those who have standardized their forms. An adequate system for ready reference to existing forms is, of course, indispensable, and the folder is the natural evolution from the scrap-book.

THE CHAIRMAN: I have an engagement at four o'clock this afternoon. I wonder if Mr. Peck would oblige me by presiding over the remainder of the meeting?

MR. PECK: I would be very glad to do so, sir.

(Mr. H. W. Peck, of Schenectady, N. Y., then assumed the chair.)

THE ACTING CHAIRMAN: The next paper is "A Suggested Extension of the Dewey Decimal System of Classification to Gas Engineering," by Mr. D. S. Knauss, of Philadelphia.

A SUGGESTED EXTENSION OF THE DEWEY DECIMAL SYSTEM OF CLASSIFICATION TO GAS ENGINEERING.

The decimal system of classification devised by Mr. Melvil Dewey has been adopted by libraries, engineers, manufacturing and business concerns generally. It affords a simple, flexible and easily recognizable method for classifying books, pamphlets, catalogs, drawings, cards, data, and information of all kinds.

The system is briefly as follows: Human knowledge is divided into ten departments with the numbers 0 to 9.

0 General works
1 Philosophy
2 Religion
3 Sociology
4 Philology
5 Natural science
6 Useful arts
7 Fine arts
8 Literature
9 History

Each of these departments is divided into nine classes by affixing another digit. For example

6 Useful arts
61 Medicine
62 Engineering
63 Agriculture
64 Domestic economy
65 Communication and commerce
66 Chemical technology
67 Manufactures
68 Mechanic trades
69 Building

Each class is again subdivided into nine other classes by the addition of another digit, after which for clearness a decimal is placed; thus

620. Engineering
621. Mechanical
622. Mining
623. Military
624. Bridge and roof
625. Road and railroad
626. Canal
627. River and harbor
628. Sanitary: water works
629. Other branches

In the same manner subdivisions may be continued indefinitely by adding numbers after the decimal, and thus the classification may be made as minute as desired.

Appreciating the demand for a much more extended division of 620 Engineering than that given by the above nine classes, the University of Illinois has published a bulletin[1] extending the system with considerable detail to the engineering industries. This bulletin should be in the hands of all engineers who plan to make use of the system.

The Illinois extension, however, contains no mention of gas engineering as such, and those few subjects which might be applicable to the gas industry are scattered under various heads. *Chemical Technology* contains "665.7 Illuminating Gases" and "665.8 Other Gases," *Mining Engineering* contains "622.7875 Gas Retorts" and "622.7876 By-product Ovens," *Heating and Ventilating* contain "697.6 Heating by Gas," and *Mechanical Engineering* contains "621.43414 Gas Producers." Obviously, for the gas engineer this scattered and inadequate treatment has proven of little value, while an extension, which would bring under one head the field of the gas industry, should find, except in special cases, almost universal use for classification.

In order to fill this need for a gas engineering extension of the Dewey system, Mr. W. A. Baehr[2] chose 629.1 *Gas Engineering* as a subdivision of "629 Other Branches of Engineering," and upon this built up a system which, while of much merit, has failed of universal recognition. Mr. Walton Forstall has also divised a decimal system covering the field of distribution practice[3], which has been successfully applied by the Philadelphia Gas Works, and Mr. H. W. Peck, together

[1] Bulletin No. 9, "An Extension of the Dewey Decimal System of Classification Applied to the Engineering Industries" by L. P. Breckenridge and G. A. Goodenough, Engineering Experiment Station, University of Illinois, Urbana, Ill., 117 pages. Price, 50 cents.

[2] Progressive Age, Feb. 15, 1907.

[3] Progressive Age, Sept. 15, 1907.

with several other engineers, has been using a general system for engineering differing radically in make up from that advanced in the Illinois bulletin. The Illinois extension, having been grounded upon the skeleton classification by Dewey made as far back as 1890, is open to a curious lack of proportion, which Mr. Peck has attempted to correct. The Illinois extension, however, has become so firmly established that it would be difficult if not impossible to make radical alternations which would be widely adopted.

In the present paper the writer has attempted to cover the field of gas engineering in a fairly detailed manner. Mr. Baehr's designation of 629.1 for *"Gas Engineering"* has been retained, which if desired may be written simply "G." Many items have been included for the sake of approximate completeness, which have also been classified in the Illinois bulletin with other divisions outside of gas engineering; in such cases their numbers in the bulletin have been given.

In applying the system considerable judgement must be used. Much information which must be classified is of a hybrid nature, containing many elemental subjects. Such information may be classified in as many places as possible, or in only one or two places of particular interest, or under a general heading. Matter filed under general headings may later be divided into more definite classes, and should always be so filed when uncertain in regard to closer classification or when time permits of but a hasty examination. When a drawer, pigeon hole or file covering a general heading has reached its capacity, subdivision of its contents may be made as desired.

An alphabetical index of the more important gas engineering headings enables one unfamilar with the system to quickly locate the proper classification numbers. After having found a number through the alphabetical index, reference should be made to the decimal index for closer classification.

Each heading as given by a decimal number may be subdivided by prefixing or affixing what are known as form di-

visions. Form divisions applying particularly to engineering are the following:

(001) Statistics
(002) Quantities and costs
(003) Contracts and specifications
(004) Designs and drawings
(005) Executive
(006) Working and maintenance
(007) Laws
(008) Patents
(009) Reports

By using these form divisions, one who is particularly interested in patents, for example, may group all patents under the division (008) while retaining the decimal classification.

NOTE.—The above is merely the introduction to the classification proper, which is in great detail, occupying, with an alphabetical index, 122 pages. It has not been printed in the PROCEEDINGS, because before adoption by the Institute, material changes are apt to be required. Also, for reference use, the pamphlet form is far more convenient, and in this shape the complete paper may be procured free of charge by each member applying to the Secretary prior to July 1, 1915.

(Mr. Knauss read an abstract of his paper.)

MR. WALTON FORSTALL (Philadelphia): Mr. Chairman, I have here a discussion which I will read, from Prof. L. P. Breckenridge, now of Yale, who prepared the extension of the Dewey decimal system to mechanical engineering while he was at the University of Illinois. He says:

"The extension presented by the author of this paper is very complete, and it is, I believe, fortunate that we can have such a carefully prepared extension presented for discussion by the American Gas Institute.

"The extension referred to by the author of this paper was brought out several years ago by the writer at the University

of Illinois and it has been in very large demand, something over 20,000 copies having been distributed to the engineers and technical libraries.

"In using such a decimal classification, one must understand that it is by no means necessary for him to consider at first the use of all of the divisions suggested, in fact, in starting a filing system according to this classification, it would be well if one should limit his classification numbers to two or not more than three figures beyond the subject number 629.1, which stands for Gas Engineering. Whenever the accumulation of material becomes large in any one division it is then time enough to make sub-divisions.

"The principal use of such a comprehensive and detailed classification is found particularly helpful in the filing of index cards referring to printed articles of all kinds. For work of this description, the number of headings will be found none too large.

"The writer has probably tried all of the systems which naturally suggest themselves for use, but none of them have ever proved as satisfactory as the decimal classification.

"It occurs to me that it might be well to introduce one or two pages of classification numbers extending only to the second figure, this to precede the more extensive classification as already printed."

The above letter indicates apparently that Professor Breckenridge's extension has met a definite need. It goes without saying that the advantages of a perfect interchangeability of references between engineers engaged in the same line of work are very great. Thanks to the Dewey system, such an interchangeability now exists among the libraries in the United States. The copyright laws require two copies of every book to be deposited in the Library of Congress. Each book so deposited is indexed under the Dewey system, and a proper card printed. A library such as the John Crerar in Chicago, which specializes on technical literature, does not have to index any American book, because it can obtain the printed index

cards from the Library of Congress. In the same way, the Franklin Institute Library obtained from the John Crerar Library certain printed cards which covered the books that the Franklin Institute is especially interested in and which are indexed in greater detail than is required by the Library of Congress. So you see that the use of one system of library classification saves a great deal of duplication of work in various libraries in the indexing of books.

This paper of Mr. Knauss' originated from a desire on Mr. Gartley's part to have a subject index made covering the PROCEEDINGS of the Institute. In thinking the subject over, and realizing that there was no standard subject index for gas engineering literature, we thought it would be best, if possible, to first agree upon such a standard index. Only those who have devised decimal systems of their own are able to appreciate the tremendous amount of work that the author has given to his contribution—work to which he devoted many rest and recreation hours. It would seem that there should be a valuable field for such a classification of gas engineering subjects, and I think that the matter should be referred to the new Technical Committee with the idea that a sub-committee be appointed to correspond with various engineering libraries throughout the country with reference to their views on this subject, and to go over the classification as proposed by the author. Undoubtedly, a committee representing various phases of the industry would be able to suggest certain changes which would make the classification scheme more nearly perfect.

Personally, I believe that the agreement of the gas profession upon some standard system of classification such as is now offered, would result in future years in greatly facilitating the labor of separating the live from the dead matter in gas engineering literature.

I sent a copy of Mr. Knauss' paper to the John Crerar Library, and received from them this morning a telegram, in which they say that from the standpoint of their books, his sub-division was a little bit too minute, but that they would be interested in a more general classification, and while they

could not speak for the American Library Association, they believe that that association would co-operate in the work.

It may prove that what we are trying to do in this regard is not possible of achievement, but it is certainly worth trying, and I personally want to acknowledge my indebtedness to Mr. Knauss for the vast amount of labor he has contributed to getting it started.

Mr. H. W. Terry, Jr. (Ossining, N. Y.): I have nothing to add to the discussion, Mr. Peck. I only received a copy of the paper yesterday, and have not had an opportunity to go over it very thoroughly, but a glance shows me that Mr. Knauss has certainly done an immense amount of work, and it is something that we have needed in gas engineering. I know that a few years ago I had some data which I wanted filed, and the main trouble was to so index it that I could readily find it. The decimal system here suggested makes filing and finding very easy.

The Acting Chairman: The matter referred to in the paper is one on which I am entitled to say a little something, even though I am in the chair. When I was at Cornell, Dr. Thurston was quite keen on the students filing technical information, and he recommended what he called *index rerum,* saying that he had tried various systems, and he found, after all, the most satisfactory thing was to get a big book, something like a ledger—12 by 18 in. is the impression of the size which I got, and maybe 1½ in. thick—and allow plenty of space after each letter of the alphabet, and put down any references which you wished to have in that, from anywhere you saw fit, in envelopes, numbered serially, or any other way.

I tried that for a while, and it didn't seem to me at all satisfactory. I tried a card index for everything, filed alphabetically, and that did not prove satisfactory. I believed thoroughly in making permanent use of some of the information for which I was paying my money, in the way of technical magazines and other ways, and information which I picked up in my regular work.

About eight years ago, after having given the matter a good deal of thought, and finding out all I could about the various systems, I looked over the Dewey system, and I found even that to be, in my judgment, which has been confirmed by others, very incomplete. For instance, under Engineering it has Mechanical, Mining, Military, Bridge and Roof, Road and Railroad, Canal, River and Harbor, Sanitary, and Other Branches. For modern engineers that is a very strange division of the general subject of engineering. He doesn't mention Civil Engineering as such, he doesn't mention Electrical Engineering, he doesn't mention Gas Engineering, nor Chemical Engineering. However, that system had obtained such standing among libraries and other filing places, that it did seem rather hard to change it, although I am informed by Mr. W. P. Cutter, Librarian of the Engineering Societies, that Dewey himself has made radical changes in the system since it first came out. That brings up what I have felt for a long time, that changes can be made, and that because Dewey got out this system 24 years ago, we have not always and forever got to be held down by it.

I worked three or four years, I suppose, on the system which I got up purely for myself, and during that time, showed it to a number of other engineers associated with me, and they seemed to find it promising enough to adopt it. At the suggestion of Prof. Charles F. Scott, Past President of the American Institute of Electrical Engineers, I wrote to the Electrical Institute, the American Society of Mechanical Engineers, the Gas Institute and the American Society of Civil Engineers, sending copies of my outline simply as a suggestion. I hold no brief for that; it is far from perfect. I think it has some good points, and is to my mind a rational division of the subject of engineering. I have done absolutely nothing to several divisions; I have not the knowledge necessary. Electrical, mechanical and gas engineering I have divided quite thoroughly, civil engineering fairly thoroughly. The others, I have done practically nothing to.

My request of those societies was that it be referred to the

library committees, and that a joint committee be appointed to establish a recognized standard engineering classification of knowledge. It seemed to me entirely feasible. My recommendation was that it be adapted to the Dewey system, so that it would as a body supplant the Dewey classification under the division of Engineering—620. At that time, I was told that we had a new librarian, and it would be referred to him, but that he was so busy with other things he could not take it up just then.

I have tried once since then to resurrect the idea, but I have not found very much encouragement. This paper of Mr. Knauss' is most encouraging, in that he has taken along this same line the one division of gas engineering, and has established, I think, a very excellent classification. If this should be generally adopted, it would be simply a matter of changing a few numbers to adapt it to such a system as I have outlined.

The system which Prof. Breckenridge, of the University of Illinois, got out, used the divisions as established by the Dewey system, but made radical changes in certain divisions; for instance, Mechanical Engineering, Railroads and Railroad Engineering, and Electrical Engineering, with a few changes in other branches. That seems to have been adopted quite generally, as indicated by the number which have been sent out, as Mr. Forstall mentioned.

It all seems to me to indicate that we can, if it is worth while, attack the thing from the base and get a complete system of the filing of engineering knowledge. I would like to see this section, in referring it to the Technical Committee, if such action is taken, following Mr. Forstall's suggestion, make the additional suggestion, that they try and awaken interest in other national engineering societies, to make up similar standard forms of classification.

I do not believe it is worth while to print in our records my classification. I have used it eight years myself, and I am proud to say that if you come into my office and ask me what information I have on a certain subject of engineering knowl-

edge, the chances are about one in a thousand that I would not be able to turn to my desk, turn to the proper number, ring for my stenographer and tell him to give me the material under that number, 28, 231 or whatever the number may be, and get you the information which I have on that subject. That is the test for a real indexing system, and also the requiring of a minimum of cross-indexing. I think it is impossible to get a system that will not require some cross-indexing; in fact, I know it is, because no one article is confined to any one subject. But I have found it very useful indeed.

Is there any further discussion on this paper?

MR. FORSTALL: I would like to pursue a little bit the line you have opened up. Undoubtedly the only reason for sticking to the more or less faulty division that Dewey made (and parenthetically I may say that Mr. Knauss' work, of course, such of it as gas engineers would agree is correct for gas engineering, is all done, no matter whether we use the particular numbers or not; it is a simple trick to change the numbers; the hard work is to think out the subdivisions and their relation to each other) was in order to tie in our classification with the big technical libraries of this country. If we find that after all, as may be true, the amount of filing done by gas engineers in their private libraries will be very much more than the filing of gas engineering literature in big public libraries, then of course the thing to do is what Mr. Peck has done—take advantage of the 24 years that have elapsed since Dewey started, and make the classification less hobbled than it is by Dewey; although, in one way, it is not hobbled at all, because, say we have to start with 629.1, we can just forget all that; those are constants; we can just let our variables go out the other side of the decimal point, if we want to.

The only objection I can see to going in with all the other engineering societies is the time it might take. Once you begin to work with all of them, it may take years.

THE ACTING CHAIRMAN: Is there any further discussion on this paper? Mr. Knauss, have you any further remarks?

MR. KNAUSS: From the point of view of a librarian, the present extension is too lengthy and some of the notation numbers too extended for complete adoption, but an abbreviated adoption of either this or some other extension should serve to assign gas engineering to its rightful place as a recognized entity, rather than, as at present, scattered throughout mechanical engineering, chemistry, physics, heating, ventilating, etc. It was in order to fill the needs of the general library at one extreme and the drafting or estimating room, where items of the most minute character need to be classified, at the other that the system was carried out in such detail. The only way to even approximately satisfy the needs of such diverse uses is to extend the decimal system to what is from some viewpoints an absurd minuteness, and then leave it to the user to carry his classification just as far as he likes. Before adoption by the libraries, many related subjects such as "Coal Mining," which have been included for the benefit of those gas engineers who do not possess the large library manual and who desire to have as much as possible of their data classified under gas engineering, would have to be eliminated, since they have been assigned other places in the Dewey system.

MR. FORSTALL: Mr. Chairman, I move a very sincere vote of thanks to Mr. Knauss for the work he has done in this connection, and that the section recommends to the Technical Committee that it take up the matter this year with an idea of having a committee appointed to take up the matter with the Engineering Societies and the American Library Association in any way which seems best to continue the subject.

(Motion seconded and carried.)

THE CHAIRMAN: The next item on our program is the report of the Committee on Rates to be presented by Mr. William McClellan, Chairman, New York.

REPORT OF COMMITTEE ON RATES.

This Committee was appointed to consider what the American Gas Institute should do to make sure that the subject of gas rates receives, from committees and at conventions, all the consideration that its importance warrants.

There has always been a moral responsibility resting on public utility companies to sell their product and service so far as possible without discrimination. Since the advent of Public Service Commissions, however, discrimination becomes more or less illegal. Gas men are now frequently asked to explain the principles on which their rates are based. Commissions frequently attempt to fix new gas rates, and in the fixing, questions of discrimination present themselves very forcibly.

The competition of electricity as well as adverse industrial and local conditions, frequently removes from the gas business the possibility of easy financial success. In many cases, it is necessary to fight hard in order to increase business and consequently, profits. Under such circumstances, a proper business-getting rate is much more important than in years gone by, and in fact, becomes a real essential to success.

There has always been a certain amount of inequity in a flat rate for any business which sells both a product and a service, but it is probably true that in the past, discrimination with such a rate has been much less than will obtain in the gas business as time goes on. When all the customers were using their maximum demands for about the same length of time per day, and when the diversity in character between customers was comparatively small, a flat rate worked comparatively little inequity. The increase of the use of gas for cooking, heating, and industrial purposes, and the decrease of its use for lighting, introduces very different conditions. There is ample evidence to show that it is a serious question if a flat rate for gas will be commercially satisfactory in the future.

There are many who think that the worst possible discrimination results from the use of a flat gas rate.

It is not desirable to enter into a lengthy discussion in regard to the reasons for this discrimination. These have been well set forth in a paper by Mr. A. S. Miller, on page 195 of the 1913 PROCEEDINGS, and in the accompanying dicussion. There seems no question that there are certain expenses which every consumer entails on the company, irrespective of the amount of gas he uses; and further, there seems no question that the relation of the maximum demand and the hours of use of this demand are becoming factors of increasing force in equitable gas rates. Every customer must have a meter and service pipe requiring a definite investment. His meter must be indexed, the accounts must be kept, he must be billed and collections made. All these expenses must be met by the company, no matter how little gas passes through the meter. Moreover, it is customary in this country to give all customers a certain amount of supervisory service in addition to the mere supply of gas. This is also a direct expense, irrespective of the amount of gas used. It has been well said that a flat rate for gas would apply strictly only where the company maintained a central distributing point in the community, and the people come with their own bags or tanks and transported the product themselves.

It is frankly acknowledged that there is perhaps not the same need or opportunity for elaborate rate studies in connection with the gas business that has been found necessary in connection with the electric business. Your Committee believes, however, that the American Gas Institute should establish a permanent Committee on Rates, and for the following reasons:

(1) In these days of increasing operating expenses and constantly lowering selling prices of gas, it becomes important that every consumer pay as large a part as possible of the cost of giving him the product and service.

(2) It is of the utmost importance that a schedule of rates be used which will induce the greatest possible use of gas.

This means that if a consumer, by his use, can earn a lower rate, this will induce him to increase his use.

(3) It is desirable to know definitely where and to what extent discrimination, if any, exists, and how best to eliminate it.

(4) Commissions are considering these questions, and it is desirable for companies to be well informed in regard to them.

(5) Should it become desirable to introduce gas rates other than flat rates, a preliminary period of investigation, education, and discussion is necessary to facilitate changes.

(6) Should a company see the desirability of a new kind of rate, and very reasonably lack the courage to make the change on account of the delicate relation usually existing between the company and its public, it would be strengthened greatly in its determination by its work and assistance of such a committee.

Such a committee would gather information from companies everywhere, and summarize this in its annual report. It would make sure that the subject of rates would be adequately covered by papers at conventions and other meetings. It might very well, if convenient, make frequent use of a page or two of the *Gas Institute News* to publish important facts in regard to rates. In short, it would seek by every means possible to make itself a useful facility, for the members of this Institute, in what will become perhaps the most important factor of their business lives.

Wm. McClellan, *Chairman,*
A. E. Forstall,
R. G. Griswold,
C. N. Jelliffe,
A. S. Miller.

(Mr. McClellan read the title of his paper only, and made the following remarks:)

Mr. McClellan: It was not proposed in this report to

make a discussion of rates. Mr. Miller in his paper last year did that, and it was pretty thoroughly discussed.

The subject of gas rates has become exceedingly important recently for several reasons. Public Service Commissions are compelled to determine on rates by the so-called "scientific" method, and companies must join in the process. In addition, the gas business has become increasingly competitive, and gas rates need, more than ever, an inducing feature.

Our electric friends have paid a very great deal of attention to rates, and the result is exceedingly gratifying from a commercial standpoint. There is perhaps less room for elaborate rates in the gas business, but the necessity for doing something is imperative.

The Committee reports very decidedly that it thinks the Institute ought to establish a standing committee on rates and some general suggestions are given as to what such a Committee might do.

I do not know that any action of this section is necessary. I understand that this report goes to the Board of Directors. There is no reason, however, why we should not make any recommendation we desire.

THE ACTING CHAIRMAN: Gentlemen, you have heard the reading of an outline of this report. As Mr. McClellan says, it is not the purpose to discuss rates in connection with this. However, we have 45 minutes time, which we can take for that purpose or for the purpose of discussing his paper, if you so desire.

MR. MCCLELLAN: I hope I didn't say that. I didn't mean to usurp the function of the Chairman of this meeting. I said the purpose of the report itself was not to discuss rates, because they had been fully discussed. I think it would be very well to discuss anything the meeting chooses to.

THE ACTING CHAIRMAN: Pardon me for misunderstanding. I thought very likely the meeting would choose to do so. Mr. Forstall, have you any comment in connection with the paper?

Mr. Walton Forstall (Philadelphia): Unfortunately, I am a distribution man, and have nothing to do with making rates. I often wish I did.

The fact that we cannot get more than a corporal's guard in this room to discuss the question of rates, is, I think, the best argument in the world that we ought to have a Committee on Rates.

I live in a city which unfortunately furnishes one of the best examples of the inadequacy of a uniform rate. Owing to our existing contract with the city, all of our gas must be sold at a uniform rate per thousand, no matter whether 100 ft. or 1,000,000 ft. are used per month.

I was talking with a man from one of the growing Western cities, who gave me some information which he did not want me to use and which fortunately I have forgotten; but the gist of it is this, that it is wonderful the tremendous amount of industrial business he has gotten since he has begun to do some scientific rate-making. I think there is a tremendous field open in all large cities, and perhaps in some small cities, for the man who is free, not held down by means of contracts and all that, to adjust his rates scientifically, and I believe that there are many people in the industry who don't appreciate the tremendous gain that can be brought both to the company and to the consumer by getting away from the old flat rate. We have been settling down year after year, and saying, "Well, we can't do it, we can't do it;" and it is a question whether everybody in their own situation has studied that problem out thoroughly, and I believe that the effect of a Committee on Rates and the campaign of education that it would conduct, would at least help to induce each man to study out his situation more thoroughly than he is doing now. This matter has never been threshed out in the American Gas Institute, and it is high time it should be.

Mr. C. M. Cohn (Baltimore): I would like to have placed in the record of this meeting that there is a Committee on Differential Rates of the National Commercial Gas Association,

and the Committee had a meeting to-day and went over a draft of a report on that subject.

The discussion of differential rates in the gas business has been more seriously considered in the last year or two. As Mr. Forstall says, it has always been considered that it would be difficult to apply to the gas business, but those who thought so then are, I believe, changing their views now. And the subject is one of great interest to the gas men.

I might add that one of the reasons, as I understand it, that gas men are rather loath to consider differential rates, is that the change would be revolutionary in the commercial dealings with consumers, but if they would look into the situation more carefully, they would find that any ordinary differential rate schedule in any of the large cities would affect comparatively only a few consumers, because the great bulk of the gas consumers are the small consumers, and they would continue on a flat rate basis. And the commercial advantage to the gas companies and the smaller consumers, as well as to the larger consumers, is that it opens up a field for the exploitation of gas which is now practically closed to the gas companies, because they have not adopted the differential rate schedule.

Mr. J. E. Bullard (Port Washington, N. Y.): At the banquet of the Gas Meeters last night, Mr. Cohn, of Baltimore, gave a very interesting talk on the securing of more business without additional investment in mains and services. He showed how dead services might be made a source of income, and how the consumption of present consumers might be increased. I believe that we can with profit go much farther than Mr. Cohn suggested.

In the gas business we are confronted by this condition. We have our mains laid and our services in. We have a great many meters set and we have a large number of customers. We, however, have possibly not as much as two hours out of every 24, when our distribution systems are anywhere near their full capacity. For the rest of the time, the system is operating at very much less than its full capacity.

Any manufacturing plant running 24 hours a day, which was running at its full capacity only 2 hours out of each 24, would not be considered as under the most efficient management. It seems to me that this low load factor condition merits a great deal of thought and research when we are planning rate systems.

As a commercial man myself, I do not think there is anything in the business requiring so much study and attention as the rates. The electric light companies have in 30 years invested 50 per cent. more money in the United States than the gas companies have in a hundred years. The electric light companies have been constantly investigating rates and making new rates. They have put new systems into effect so rapidly that you can scarcely find any two companies using exactly the same systems of rates. They, nevertheless, are all getting business.

I have sold electric power myself, and found that the profitable business was easy to get because we had rates to attract it. The unprofitable business, such for example as a saw used for sawing wood only once a month, would be given to the gas company. Any business requiring a very large demand for a very short period of time during the month, and with a comparatively small consumption, the gas companies can secure with the present rate systems. However, with the rate systems we usually find in force by the gas company, it is at a very great disadvantage when it tries to secure the profitable business, the loads which are uniform 24 hours a day, and which will load up the present distribution system and bring in large returns. All such business is usually turned over to the electric light man because he has a very attractive proposition to offer that class of business. For the reason that they cannot store electricity, the electric men have realized right along that their success depends on a high load factor. There are now a number of electric light plants in this country having load factors above 60 per cent. I do not think there are many gas plants with a 50 or 60 per cent. load factor at their holders.

If we do not take into consideration the fact that there is a big investment tied up in our mains and services, and that though we can store gas, we are not using those mains and services to the best advantage unless we do have a scientific rate that will encourage people to use our product longer hours, we never will be able to get those mains and services loaded up to full capacity.

It seems to me, in spite of the fact that some gas men do not think so, that it is just as important for the gas industry to make rates that will encourage long hours' use, as it is for the electric light companies to do so. We are able to store gas in holders while they cannot store electricity in holders. The works and offices, however, are not the main investment. The main investment is in the distribution system. It is this investment that we want to keep the busiest. If we can keep it loaded right up to full capacity, or if we average to operate it at only 60 or 70 per cent. of its full capacity, we are not only going to have a bigger revenue, but we are going to be able to secure profitable business now out of our reach. We are going to be able to continue this process just as the electric lighting companies are, till we secure all the good business and new business in the territories we serve. The electric light companies will then not have as easy a time securing the profitable business and giving the unprofitable business to the gas companies.

I know of one electric light company up in New England that has already introduced an electric cooking rate of $2.00 for each four kilowatts or less of demand and two cents for each kilowatt hour used. The rate probably will prevent a gas company entering a suburban territory this company serves. They are striving to secure all the business there is. It seems to me that it is extremely important that the American Gas Institute goes into this matter of rates very thoroughly, and that it takes into serious consideration the fact that we already have made a big investment that could be made to yield a great deal bigger return if we would only look into this matter

a little closer and intelligently try to persuade people to use their gas over a longer period of time rather than to use it all during an hour or so of each day.

Mr. W. H. Gardiner (New York): In this rate matter, I happen to have had the pleasure of being one of the members of the Rate Committee of the National Commercial Gas Association, and it is a question in which I have taken personally a very great interest for a number of years.

In this connection, there are perhaps one or two items of history that may be pertinent to the American Gas Institute at this time. The Western Gas Association appointed a committee on rates which reported to the American Gas Institute in 1906, just scratched the territory, opened it up, and pointed out one or two of the major lines of research which looked as though they might be followed up to advantage, but these ideas did not seem to be welcomed at that time, and since then, as far as I know, the matter has been rather quiescent.

In connection with the work recently done on rates by the National Commercial Gas Association, a letter was sent to something over 1,000 gas companies in this country and Canada last spring, asking for detailed information about their rates. The replies received showed some very surprising results. We, I imagine, think that the uniform rate by meter is the standard way of charging for gas. Thirty per cent. of the gas companies which replied said that they used the uniform rate by meter exclusively. Seventy per cent. used other rates. This does not look as though the uniform rate by meter were universal.

A number of discussions incidental to this work and other work, have rather given me the impression that gas rates have been evolved, in so far as they have gone beyond the uniform rate, very much under the inherited influence, of this uniform rate. There has been but slight differentiation from it. There has been but little, if any, really fundamental cost analysis done, not to see how high we could hold our differential revenue, how economical the differential cut might be, but to

see how low we can go and how broad a differential we can make.

I think it would be interesting just to go back to the electrical history on that. In the electric light business, in the early days, we had uniform rate by meter, and then slight quantity increment systems from that to meet the wholesaling function, and so forth. And then the electric men woke up to the idea that there was a vast amount of business unobtainable at ten cents, unobtainable at eight cents, unobtainable at seven cents; but if their increment current cost them only two cents at the switchboard, this vast amount of business might be awfully profitable at four cents, if they could pay their way as they go with their other business; and I know from service on the Rate Committee of the National Electric Light Association that the general theory has been, not to see how economical a differential we would make, but to see how broadly we could differentiate so as to go into as broad markets as possible, and find a profit wherever we went. And frequently the profit from the low priced business has been greater than the profit from the high priced business. I remember Mr. Hale once said that some of our kilowatt hours cost us over $1.00, and others cost us less than a cent. There was obviously more profit in selling the latter at two cents than the former at ten cents. And the same is true of the gas business, within certain limits.

Reference was made by the previous speaker to the importance in the gas business of the long hour burning customer and of the load factor. I was reminded of a paper which I gave before the New England Association of Gas Engineers in 1908, on the readiness to serve costs of gas supplied. It was simply drawing the parallel between Dr. Hopkinson's old paper, delivered in England in 1893, in which he proposes the Hopkinson rate, and the conditions existing in the gas business; and from calculations appearing in that paper, it would seem not that the readiness to serve costs in the gas business are not as important as they are in the electric light

business because of the holder, but that the holder merely saves the gas business from having readiness to serve costs much more important in the gas business than they are in the electrical business.

The discussion of that paper interested me very much. A number of gentlemen, very prominent in the gas business for many years, were present and took some part in the discussion. There did not seem to be any radical difference of opinion as to the reasonableness of the cost analyses made, but they always came back to the idea that the public will not stand for differential rates in the gas business. Well, that may be so in the gas business; on the other hand, your wholesale customers or the future wholesale customers of the gas business, are probably pretty much the same type of men as the present wholesale customers of the electrical business, and I do not see why what has worked in one business should not work in the other business. Of course, I remember, back in the nineties, there was a good deal of discussion in the electrical business, as to whether the public would stand for differential rates. The advocates for these rates were very much misunderstood, both in and out of the profession, but they kept at it, and they proceeded to evolve rates based on various more or less fundamental principles, to put up logical arguments for them, and to make them stick, and the net result from a census point of view is this, that the gas business has been going along and saying, "The public won't stand for differential rates," and increased during the last census period something like 60 per cent.; and during the same period, the electrical business increased over 200 per cent. in the same terrritories.

To-day we are losing more or less of our old lighting business, having the cooking, water heating, beginning to scratch the industrial fuel field, and so on; but we have not revolutionized the business very much in the last 10 years. On the other hand, in the electrical business to-day, business which 10 years ago was the main source of revenue of an electric

light company, the retail and semi-retail lighting business, is the by-product business in many, many situations; that is the side issue; and the big revenue, in bulk and very often in profit, is coming from low priced wholesale, long hour burning business that we never dreamt we could touch 10 years ago.

Now if this has worked in the electrical business, as it has, it seems to me most important that we should set aside all of our preconceptions, all of our conventions in the gas business, and try to go to the fundamental factors influencing this condition, and if we can put our hands firmly upon them and work logically with them, I see no reason why, in the next decade, the gas business should not double, and then double in the decade after that. But if we are going to keep on as we have been going in the past, why our career will probably be similar to recent history. (Applause.)

THE ACTING CHAIRMAN: Mr. Offutt, I believe, has recently started a brand new plant in a brand new place. I would like to ask him whether he established a scientific rate, and if not, why not?

MR. M. W. OFFUTT (San Juan, Porto Rico): I feel that this discussion of rates means more to us than anything else I can think of in connection with the gas business. This has been very much brought home to us in the last year.

We are operating under a rate possibly higher than we should have started out with; but this was one of the conditions established prior to our entry into the situation and our bankers were unwilling to change, as they felt that once having started, we should continue with that rate for a time.

We are now seriously considering the advisability of revising our rates and the definite form our new scale should take, with especial consideration to the points on the scale where the reduction or steps should occur to fit our particular conditions.

Our rate is not a straight line rate, but is on a sliding scale —but it doesn't begin to slide until the consumption gets pretty high (laughter), and consequently, it doesn't mean very

much to the majority of our consumers, from whom we should expect the benefits of a judiciously arranged quantity discount.

On this question of rates, I heartily agree with Mr. Gardiner when he said that what has been considered before as wholesale business which we have taken on possibly to help out a bit, could readily be made the source of our greatest profit. Our sliding scale does not begin to show a reduction as soon as it should, and this is not only true in the case that I speak of, but in many other companies, copies of whose rates I have recently reviewed. It is evident that all gas companies should give this subject much careful study, at as early a date as possible, since the adoption of a logical rate schedule will do more to develop their business than any other step they can take.

I will go back and say that I think that our rates in the past have been made in a more or less haphazard manner, especially in sticking to the old straight line or flat rates. The gas companies have not generally availed themselves of the step rate or the block rate, as the electric companies have. When I say electric people, I am speaking from some experience, and I know from actual experience that the use of the block rate in some of the companies I have been associated with, has resulted in our securing a great deal of business which we probably would not have gotten otherwise, and under conditions satisfactory both to the consumer and ourselves, and I would emphasize this,—that this condition of satisfying the consumer is of primary importance.

THE ACTING CHAIRMAN: Has it resulted in much trouble also?

MR. OFFUTT: It has resulted in absolutely no trouble. I would like to speak of that.

There was one thing I was impressed with in listening to the preceding speaker's remarks, that is, I do not think we would be burdened by a great deal of explanation to our consumers in regard to why we are using, say, a block rate, or

some rate that showed a differential in favor of the large consumer; on the contrary, I feel that the consumer accepts this fact more readily than the gas companies generally imagine. The question of a quantity discount is a very logical thing, and I think that the gas companies have been frightened unnecessarily by some imaginary bugaboo that would arise if they put in a differential rate. It exists in almost every other industry, and there is no reason in the world why it should not be practical for gas companies to give a lower rate, based on either quantity or class of service, as in the case of electric service. It is a question to which we should give much study and careful thinking, as it seems that only a comparatively few of our gas companies have applied the step rate, and practically none the block rate, to their company's business. This I find is true even in combined gas and electric companies where they have given exhaustive study to the use of a sliding rate on the electric side of their business.

I wish I had here some papers which I recently compiled in regard to our own consumers; and I think if any one would take all of his consumers by blocks, taken in steps of 500 cu. ft. per block, and showing the consumption of gas in that block and the percentage, namely, the ratio of the number of consumers in that block to the total number of consumers, and the ratio of gas consumed to the total amount of gas consumed, it would be very enlightening and would constitute a most convincing argument, towards the use of a block rate scale. Personally, I think the block rate constitutes a splendid argument to the consumer, as the small user can see at a glance that the larger user pays exactly the same price for the same quantity as he does and vice versa; he can get the lower price obtained by the larger consumer by using the same quantity. Now on the electric side, we have had occasions when some small consumer has come in, to complain of the fact that a larger consumer was getting a very much better rate than he was. In every case I have ever known, he was convinced and went his way satisfied, and often with the awakening

consciousness, even if not expressed, that the company was doing its best to give him not only good service, but was equitable in its charges. (Applause.)

THE ACTING CHAIRMAN: Mr. Graf, I believe that in Indianapolis they have an exceptional send-out of gas. Is that due simply to a low uniform rate, or to scientifically planned rates?

MR. CARL GRAF (Albany): I do not believe they have an exceptional send-out per capita. There, I believe, they have the lowest rates there are in the country, and the business has increased uniformly.

THE ACTING CHAIRMAN: Is it a uniform rate, or a block sliding rate?

MR. GRAF: They have had all kinds of rates. They had block rates and step rates, and also uniform rates, but for the past few years, it has been a block rate.

THE ACTING CHAIRMAN: Did the introduction of that seem to bring a large amount of new business?

MR. GRAF: Well, we did not reach a certain class of business as Mr. Gardiner expressed it, with an 8 cent rate or a 6 cent rate; we could not reach that class of business on a certain price for gas, and we had the gas to sell, so we put the rate down under the block system to reach that business, and got it. Of course, Indianapolis is a very large manufacturing city, and there is a vast field for the use of industrial gas.

THE ACTING CHAIRMAN: Were you under the control of any commission at that time?

MR. GRAF: We were not.

MR. GARDINER: Mr. Chairman, may I say one word more?

THE ACTING CHAIRMAN: Certainly.

MR. GARDINER: Mr. Offutt laid great emphasis on the block rates and step rates. It seems to me that in the gas business to-day we have an extraordinary opportunity to, as I personally happen to think, avoid making one of the mistakes that the electrical business made a number of years ago. I never have been able to see very great differences between the

fundamental economic problems of the two forms of service. Therefore, I am all the time mentally drawing analogies between the two, and using what I find in one as applied to the other and vice versa. In the electrical business we had this history: We had first the flat rates, so much per lamp or so much per outlet; then the old chemical meters, and finally the mechanical meters came along, and the business flopped right over to the uniform rate by meter. Well, we went from that on to the quantity increment of the block system or step system, and got along on that a good deal better than we had gotten along on the uniform rate by meter.

But as we were getting to analyze our costs more and more accurately, we found that the wholesaling function, which is the function principally attended to in the block or step system, was really much less important than the load factor question. And if you make a little fundamental differential analysis of gas costs, you will find the load factor just as important in gas as in electricity, I think. Then when the electrical men found that the load factor was more important than the wholesaling function, in their efforts to get their rates down so that they could get the volume of trade, the volume of business, the big wholesale business which now constitutes their most profitable business and their biggest volume of business; when they found that the load factor was the most important thing in that, or rather more important than the wholesaling function, they developed load factor rates and their allowance. The first one was Hopkinson, and then came along Wright, and then Doherty, and since then there have been a number of load factor rates.

Now, what seems to me the opportunity of the gas business to-day is this, that we have gone along more or less on the uniform rate by meter and a certain amount of wholesale by the block schedule and step schedule, but we have not really put our hands on a definite form of rate that we want to use; and it seems to me that we have got a wonderful opportunity to just take one wholesale step over the long process of evolu-

tion that was carried on, for their own sake and not for our sake, by the electric light associations and the electric light men in evolving their rates. In other words, we can pick this problem up to-day, not where they were 10 years ago, or 15 years ago, dealing merely with their wholesale function, but where they are to-day, and carry it right on in the gas business from that, if we are willing to tackle it without preconceptions and without too much respect for the conventions of the business.

THE ACTING CHAIRMAN: Mr. Gardiner, do you happen to be fortunate enough to have been able to put into actual practice your most carefully considered ideas regarding a proper gas rate?

MR. GARDINER: I have not personally dominated the situations, but I am speaking as having co-operated with a good many of them, yes.

THE ACTING CHAIRMAN: Did you actually establish rates based upon a consideration of the load factor?

MR. GARDINER: Yes, to a certain extent.

THE ACTING CHAIRMAN: What is the nature of such rates?

MR. GARDINER: Well, for instance, you take a rate where we charge $1.00 a month per customer, and $24.00 per annum in equal monthly installments, per 100 cu. ft. of maximum hourly demand, and sell all gas actually passed through the meter at, we will say, 60, 65 or 50 cents a thousand.

THE ACTING CHAIRMAN: Where is that rate in effect?

MR. GARDINER: I do not know that that is a specific rate, but there is a similar rate to that in use in Denver and in a number of the cities. 8.8 per cent. of the companies which replied to our inquiries, had such rates optionally. They have always got to be optional, because we have made the mistake of getting our uniform rates too low, so low that we cannot put a rate like that in without increasing the price to a lot of small customers whom we are now carrying at a loss on the uniform rate by meter.

THE ACTING CHAIRMAN: Do results in those places, from

the growth of the business or the consumption per capita, show the great benefit of such a rate over the rate in vogue in other places?

Mr. Gardiner: I think I can give you one or two figures which have recently come to hand. It seems that in the gas business, those companies that have never used a differential rate think that it might help their business to increase possibly 10 per cent. I am speaking of actual average figures obtained from this canvass of a thousand companies. That is not analogous to the electric light experience, and I do not agree with that figure myself.

The gas companies which have used differential rates of the nature usual to the gas business, which I characterize personally as differential rates of a very narrow differentiation, that is, we will sell the first 50,000 a month at $1.00, and the next 50,000 a month at 95 cents, and all in excess of 100,000 a month at 90 cents; the gas companies which have used such rates ascribe, I think, about 15 per cent. of their increase to differential rates. Among the companies which replied to our inquiries, a number of the companies using the kind of rate that I have been speaking of, the load factor rate, made replies, and they thought that they had grown from 50 to 75 and 100 per cent. as a result of that rate; and I do not think those rates have ever been carried out to their ultimate conclusion, that is, the output cost has been held too high for revenue.

The Acting Chairman: They have been feeling their way.

Mr. Gardiner: Yes. We asked the question, "If you had a profitable rate which would get all the business in town, which you do not now have, what would be the increase over your present business, stated in per cent.?" Well, nineteen companies said that there would be no increase. Several companies said that they were doing all the business there was to be done in town, and there wasn't any more business to be done in town, and they couldn't get any more business at any rate. And then a number of companies put in varying esti-

mates, ranging from 5 per cent. to 300 per cent. The weighted average of them was 25 per cent., I think. That is, if we get all the business in town that there is possible to be done at any rate, and assuming that we can make that rate profitable, the gas business can only grow, in its present situations, about 25 per cent.; we are doing 80 per cent. of all the business there is possible to be done. I don't believe it; I would rather have the business we are not doing than the business we are doing.

THE ACTING CHAIRMAN: Mr. Griswold, can you say anything further on this question, particularly from your experience?

MR. R. G. GRISWOLD (New York): I do not know that I can add very much. I did not get here in time to hear the first part of the discussion.

One case where I know the rate that Mr. Gardiner was talking about has been used, is where a company was not able to meet its interest charges, and analyzing the expenses they found that they had very heavy overhead charges. The amount of gas that they sold for the amount of money they had invested was small. The maximum rate was $1.50 a thousand, and if they cut that rate in order to get some other business, they lost part of the present revenue. And in that case, they analyzed individual customers, and they found that there were some large customers that were so large, and had so large a demand, that they required a large distribution system, and that they were more expensive to handle so far as installation was concerned, than the small customers; if they began to cut the rate to those people, they would have to take on other customers who perhaps would not pay for their fixed charges. By using the rate which Mr. Gardiner outlined, they were able to eliminate from any rate reduction all the present customers, practically without exception, and yet make an inducement at, I think it was, about 60 cents a thousand, for the added use of gas if their demand was not increased any.

The particular form that Mr. Gardiner mentions, personally

I like to use, because it seems definite. There are other forms, and it is surprising how many different forms of rates we have which if properly proportioned will give exactly the same results.

While I am on my feet, I want to say that the Manufacturing Section is talking about purifying installations, and purification amounts, including fixed charges to not over two cents a thousand. The Chemical Section is studying physical chemistry, and manufacture represents at the outside, we will say, 20 cents a thousand. They can only save a part of that. Now this subject we are taking up is rates, and that represents not 2 cents nor 20 cents, but $1.00 a thousand, and it seems to me that if those people can save anything on purification or on manufacture, certainly we ought to be able to find as much by studying rates.

The Acting Chairman: Before asking for formal action in referring this to the Directors, I want to add to the suggestion, that the Committee prepare certain scientific forms of rates, and ask the companies to state their present rates, and also, to state what they thought they could establish in the scientific form that the committee suggests, if they had the nerve to establish such a rate. I know in our case I will be glad if you will suggest a three-rate system; for instance, a customer charge, demand charge and consumption charge, to figure out what our rate would be in my best judgment, and submit that to the committee. I believe a comparison of that sort would be very interesting, to show the analyses the different companies might make along that style of rate.

Mr. P. S. Young (Newark): Mr. Chairman, I am sorry that I did not hear the paper read, but there is no doubt about the subject being timely.

In connection with the suggestion that the Chairman has just made, it occurs to me that as the National Commercial Gas Association has the information at hand, received in answer to inquiries sent out by its Committee on Differential Rates, it would be very glad to give it to the committee, if

the Board of Directors should decide to appoint such a committee upon your recommendation.

The question is timely, I think, not only because the electric people have cleared the way for us by the adoption of class and differential rates, but also because the commissions have made our position more secure. Gas companies in the past have been too much influenced in their decisions on rate matters by the average cost. They have assumed that if the average cost showed, we will say, a 65 cent cost, (without including fixed charges), a rate could not be made, whose last steps were below the average cost, with a resulting profit. Now an analysis of the situation would very quickly show that additional business to the extent of a large percentage of the total sales can be obtained at a profit at rates which in their last steps are less than the average costs.

The effect upon the community of a differential rate, which in its lowest step or in its secondary charge, is below the average cost has been present in the minds of a great many gas managements. If, in a given community, such a rate were put into effect, it would cause dissatisfaction unless the matter was thoroughly understood by the public. It is difficult to get the attention of the community centered on the facts. But here is where the usefulness of a commission comes in, and notwithstanding what has been said upon the desirability of educating commissions, governmental regulation must protect gas companies against interested political agitation by interposing their authority and providing for a proper presentation of the facts and an independent judgment of the fairness of the rates to be charged. I think this is an important factor, and it should give such a committee as is proposed encouragement. It will not be thrown out of the door of the gas company's managerial rooms upon merely mentioning a rate that might be in its lowest steps or in its secondary charges below the average cost.

As I said before, Mr. Chairman, although I consulted with only one member of the committee of the National Com-

mercial Gas Association before I got up, I am sure that that committee will be glad to give the committee of the Institute such information as it has upon this subject.

THE ACTING CHAIRMAN: I am glad to know that in the National Commercial Gas Association this work is being taken up also, and I am going to suggest, in making the motion regarding the work of this committee, that it be considered in the wording of the motion. Thank you very much for the offer.

MR. C. W. HOY (Glassboro, N. J.): Mr. President, it just comes to my mind that for two cents the ordinary consumer can take the matter of gas rates up with the commission, and soon show the company, or rather have the company find out, that about 45 per cent. of their consumers burn only 15 per cent. of the gas. On that analysis the company soon comes to the conclusion that had they not made the investment for those 45 per cent. of the consumers, they would have been better off; they would have been better off if they had paid these people so much to keep off the line.

Now it seems to me that if we had a differential rate put into service, similar to the ones they have, as I understand it, in Lyons, New York, and Auburn, New York, and I think Newark, New York—50 cents a month customer charge, and 90 cents a thousand as a commodity charge—I think if that was put into effect, no commission would give you any trouble on it, and the consumer would be absolutely satisfied after, say, the first six months or a year. It is about time that the differential rate was adopted and this matter straightened out.

THE ACTING CHAIRMAN: For the sake of accuracy in the record, as you gave the rate in Auburn and Newark, I would say that in Auburn it is 50 cents plus 80 cents per 1,000, and in Newark, 50 cents plus 90 cents per 1,000.

MR. MCCLELLAN: I am very glad that the question of increment cost was brought up. I have heard one very prominent commissioner say that you were justified in making a rate for any class of business which would result in leaving

you a dollar in your treasury at the end of your operations, which you would not have otherwise.

In the particular rate referred to, namely, 50 cents service charge and 80 cents per 1,000 ft. additional, we have an illustration of how history may affect the rate making of a particular company. Under such a rate, a user of only 1,000 ft. of gas would have to pay $1.30 per month. If it is desirable to put such a rate in a town where there has been dollar gas or even cheaper gas, the result is a raise of rates to small users. Justifiable as the raise may be from the standpoint of costs, the question of public policy may be controlling. A small user is a very powerful element in any community because he has just as much voice as anyone else, and every one of him has a vote. A system of rates may be scientific if possible, but it must be commercial. It is not always possible to get your scientifically figured profit from every class of business.

The reference to the National Commercial Gas Association is hopeful. I have been accustomed to say that rate making is 95 per cent. commercial and 5 per cent. engineering. This, however, is not strictly true. I think a commercial man is the worst possible person to have complete control of rates, and the engineer is just as bad. In other words, good business wants to take advantage of the conflicting aims of the two departments of our work.

In the past, any of you who have had experience with electric rates know that when the commercial department has been allowed to run riot, there has been business taken which did not have any profit, and when the manufacturing man took control, certain good business, based on increment cost was refused. I have seen it time and time again. That is one trouble with our commission-made-rates,—they are too scientific. Every rate that a manufacturing man works out as being purely scientific ought to be handed over to the commercial department with the question, "Do you think you can get business on it?" Any good general manager will always

put a foil in the hand of the commercial department and another foil in the hand of the manufacturing department, let them fence a little, and act as referee to settle the question himself.

Now I think perhaps there might be something of that kind worked out here, so I hope the suggestion will be followed out in the best possible way to harmonize and bring together the efforts of both associations.

THE ACTING CHAIRMAN: Mr. Forstall, you made the suggestion; will you formulate the motion?

MR. FORSTALL: Yes, I would like to. Before I make that motion, I would like to say that this record, of course, will be before the Board of Directors of the American Gas Institute, and Mr. Young's invitation to use the information in the National Commercial Gas Association records, and it seems to me as if they might very wisely consider what amounts to a joint committee action practically, on the subject of rates, between the two associations.

I move that this Section endorse to the Board of Directors the recommendation of the Committee on Rates, that the Institute establish a permanent Committee on Rates.

(Motion seconded and carried.)

THE ACTING CHAIRMAN: That closes the work of this Section.

Adjourned, 5:20 P. M.

In Memoriam

AUGUST 31, 1914

FRANCIS V. T. LEE,	Died August	17, 1913
JOSEPH E. HODGSON,	Died October	26, 1913
BYRON E. CHOLLAR,	Died October	27, 1913
RICHARD H. THOMAS,	Died December	8, 1913
WILLIAM D. MARKS,	Died January	6, 1914
CHARLES F. PRICHARD,	Died January	21, 1914
HENRY PRATT,	Died February	27, 1914
STUART WOOD,	Died March	2, 1914
JACOB L. HAEHNLEN,	Died March	10, 1914
RICHARD WILLIAMSON,	Died March	16, 1914
HENRY PETERS,	Died March	20, 1914
L. L. MERRIFIELD,	Died June	21, 1914
JOSEPH E. J. MAYER,	Died July	10, 1914

FRANCIS VALENTINE TOLDERVY LEE.

Mr. Lee, Assistant to the President, Pacific Gas and Electric Company, San Francisco, California. Born, Winchester, Hampshire, England, August 28, 1870, died, Victoria, B. C., August 17, 1913. Son of Francis V. T. Lee, of Shropshire, England, an officer of the Queen's Own Light Infantry.

His school and college training was as follows: Manchester Grammar School, Manchester, England. College Communal, Boulogne, s. m., France. Leland Stanford, Jr., University, California, was graduated 1897, B. A. in Electrical Engineering.

Mr. Lee came to Sherbrooke, Canada, in 1887, and engaged in railroad work and later became connected with the Manhattan Electric Company of New York, after which he entered and graduated from the Leland Stanford, Jr., University in 1897, B. A. in Electrical Engineering. For several years he was engaged as an electrical contractor and early in 1906 he severed his connection with John Martin & Co., but followed Mr. Martin's interests into the Pacific Gas and Electric Co., where he was made Assistant to the President. As such he was generally responsible for the construction and operation of the hydro-electric developments of that company. About three years ago he resigned from the service of the Pacific Gas and Electric Company to rest and to enjoy his well-earned competence.

At the time of his death he was a member of the American Gas Institute, 1908, the American Society of Mechanical Engineers, the Institution of Electrical Engineers, the American Institute of Electrical Engineers, the American Society of Civil Engineers, and the American Electrochemical Society.

JOSEPH ERNEST HODGSON.

Mr. Hodgson, Manager Fulton County Gas and Electric Company, Gloversville, New York, an active member since 1911, died at his home in Gloversville, October 26, 1913, when

only 40 years old, having been born in Brooklyn, N. Y., May 27, 1873.

His death was traceable to an operation for appendicitis made about a year before his death, from the effects of which he never thoroughly rallied.

He was a graduate of the Brooklyn Polytechnic Institute, and of Cornell University. He was connected with the Westchester Lighting Co., when the corporation was controlled by the United Gas Improvement Company, and was transferred to the home office in Philadelphia when that corporation passed into the control of the Consolidated Gas Company.

Mr. Hodgson was also a member of the National Commercial Gas Association and the Empire State Gas and Electric Association.

BYRON EDGAR CHOLLAR.

Mr. Chollar, an active and charter member, was one of the older members, having joined the American Gas Light Association in 1888, the Western Gas Association in 1884, of which he was President in 1893, and the Ohio Gas Light Association in 1889. At the date of merger he was an honorary member of the Ohio Association. Mr. Chollar was the inventor of the Chollar system of gas purification and up to the time of his death, October 27, 1913, was always deeply interested in the gas business. He was one of the most active members, contributing liberally of his time and talents to Association work as the records clearly show.

Mr. Chollar was born in Brooklyn, Conn., in 1840 and was therefore 73 years old. He was educated at the College of the City of New York, and served through the Civil War as a member of the Fifteenth Volunteer Engineers of New York.

After the war he supervised the gas works of Binghamton, N. Y., Leavenworth and Topeka, Kansas. In 1891 he was made Chief Engineer of the Laclede Gas Co., St. Louis, Mo., which position he held until he retired in 1907.

Among his papers was one before the American in 1889, the

Ohio in 1900 and 1902, the Western in 1888, 1892, 1893, 1896, 1899 and 1905, and the Wisconsin in 1902.

RICHARD H. THOMAS.

Mr. Thomas, President of the Thomas, Roberts, Stevenson Company, Philadelphia, became an Associate member of the American Gas Light Association in 1904 and a Charter Associate member of the Institute in 1906. He was also an early and active member of the National Commercial Gas Association.

Mr. Thomas, who died December 8, 1913, was a successful business man and being of a genial disposition had a large circle of friends.

WILLIAM D. MARKS.

Mr. Marks, Consulting Engineer, who died January 6, 1914, became a member of the American Gas Light Association in 1900, and in the merger became a Charter member of the Institute.

Mr. Marks connection with the gas industry was noted by his many testifyings on gas rates in the various courts and hearings throughout the country. He was in his 65th year and at the time of his death had just completed his book "Practical Rate Making and Appraisement." He was at one time Whitney Professor of Dynamic Engineering, the University of Pennsylvania. He was also an Honorary Member of the Franklin Institute.

CHARLES F. PRICHARD.

Mr. Prichard, Vice-President and General Manager of the Lynn (Mass.) Gas & Electric Co., was a Charter member (1906) and a Past President of the American Gas Institute, having been elected for the year 1909-1910.

Mr. Prichard was born in Marblehead, Mass., June 10, 1856, attended school there and was graduated from the Massachusetts Institution of Technology in the Class of 1876 with the degree of B. S. He began active work as a clerk with the

Worcester Gas Light Co., going from there to Pontiac, Mich., as superintendent of the gas company in that city. A few years later he accepted a position with the Dedham (Mass.) Gas & Electric Co., and in 1883 he became Superintendent of the Lynn Gas and Electric Company until 1901, when he became general manager, and in 1908 became Vice-President.

Mr. Prichard was also a director in the gas companies of Salem, Brockton, Beverly, Gloucester, Fall River and the Essex Trust Co., of Lynn.

Mr. Prichard was a Past President of the American Gas Institute, New England Association of Gas Engineers, New England Guild of Gas Managers, American Gas Light Association, and Past Secretary, New England Association of Gas Engineers.

Mr. Prichard was an unusually popular man and numbered a very large circle of friends.

HENRY PRATT.

Mr. Pratt, President of the Henry Pratt Company of Chicago, a concern well and widely known in steel construction circles, died in his home in that city February 27, 1914.

Mr. Pratt was born in Fort Wayne, Indiana, March 25, 1844, and in his 28th year entered the service of the Peoples Gas Light and Coke Company, Chicago, eventually becoming its superintendent.

In the 80's he became interested in steel construction and among other work erected the steel tube in the La Salle Street tunnel. He was also prominent in the construction of the important piece of engineering, the Michigan Central Railroad's tunnel under the Detroit River to Detroit City.

He was an Associate Charter member.

STUART WOOD.

Mr. Wood, Treasurer of the Macon (Georgia) Gas Light and Water Company and one of the firm of R. D. Wood & Co., died March 2, 1914.

Mr. Wood was also Treasurer of the American Academy of Political and Social Science.

Mr. Wood was a Charter member (1906) of the American Gas Institute and took an active interest in gas matters.

JACOB L. HAEHNLEN.

Mr. Haehnlen, an Associate member (1912) was actively engaged in coke oven and by-product plants and until very shortly before his death was connected with the Woodward Iron Co., Woodward, Alabama. Early in 1914 he accepted a position as Engineer of the Laclede Gas Light Co., St. Louis, Mo., was temporarily residing at the Missouri Athletic Club and perished in the fire which destroyed that building March 10, 1914.

Mr. Haehnlen, although but a short time a member, had taken a very active interest in the work of the Institute.

RICHARD WILLIAMSON.

Mr. Williamson, head of the Gas Fixture firm of R. Williamson & Co., of Chicago, died in the Presbyterian Hospital in that city, March 16, 1914.

Mr. Williamson became an Associate member of the Institute in 1908.

He was born in Scotland and located in Chicago when 19 years of age and from small beginnings gradually built up a very large and successful business.

He was well known and very generally liked.

HENRY PETERS.

Mr. Peters, Superintendent North Station, Peoples' Gas Light & Coke Co., Chicago, who became an Active member in 1910, died March 20, 1914, from hardening of the arteries at the age of 67 years.

He enlisted in the army when 15 years old, served through the entire war—was wounded three times and honorably discharged in November, 1865. In 1870 entered the service of

the Chicago Company and in 1892 became Superintendent of the North Station until he retired in 1912.

LEONARD L. MERRIFIELD.

Mr. Merrifield, M. I., M. E., Chief Engineer of the Economic Gas Apparatus Construction Co., died suddenly at his home in Toronto, Canada, June 21, 1914.

Mr. Merrifield was but little in the public eye, but in the circles in which he lived his active life, he commanded admiration, respect and confidence. Thoroughly absorbed in his profession, he was fully informed on all matters relating to gas practice and modern manufacture.

He became a member of the American Gas Light Association in 1898 and the Institute in 1906, and at the time of his death was Consulting Engineer to several important gas companies, including the Consumers Gas Company of Toronto.

J. E. J. MAYER.

Mr. Mayer, Manager of the Commercial Department of the People's Gas Light & Coke Company, Chicago, and who became an active member of the Institute in 1908, died July 10, 1914.

Mr. Mayer was born in Natchez, Mississippi, 51 years ago. He had a High School education and after engaging in various business enterprises he accepted a position as bookkeeper with the old Mutual Company, Chicago, before this Company was merged. After the consolidation, Mr. Mayer continued in the employ of the People's Gas Light & Coke Company and was later transferred from the Accounting to the Street Department, after which he was appointed Purchasing Agent, which position he occupied until September, 1911, when he was appointed Manager of the Commercial Department of the Company. His death was very unexpected as Mr. Mayer was apparently in perfect health up to within a short time prior to the end. His death was due to failure of the heart superinduced by an attack of acute indigestion.

This Constitution to go into effect September 1, 1915.

CONSTITUTION AND BY-LAWS

OF THE

AMERICAN GAS INSTITUTE

CONSTITUTION

NAME.

SECTION 1. The name of this Association shall be the American Gas Institute.

OBJECTS.

SECTION 2. The objects of this Institute are to amalgamate into one body the American Gas Light Association, the Ohio Gas Light Association, and the Western Gas Association, and to facilitate co-operation between the various state and district associations that now exist, or may hereafter be formed within the territory covered, and to secure thereby the more rapid promotion and advancement of scientific and practical knowledge in all matters relating to the construction and management of gas works, and the manufacture, distribution and consumption of gas; the firmer establishment and maintenance of a spirit of fraternity between those interested in the gas business by affording opportunity for social intercourse and friendly interchange of information and ideas; the inducement and extension of more cordial and friendly relations between gas companies and consumers of gas based upon their mutual interests, and the education of employees of gas companies to enable them to better perform their duties. Also to take over such property and assets of the associations named as may be legally invested in the Institute.

MEMBERS.

SECTION 3. The membership of the Institute shall consist of Honorary Members, Active Members, Junior Members and Associate Members. Honorary Members, Junior Members and Associate Members shall not be entitled to vote except in Section meetings as provided in Section 39 hereof, nor to hold office, but shall be entitled to all the other privileges of membership.

SECTION 4. Honorary Members shall be persons whose scientific or practical knowledge in matters relating to the gas industry, and whose efforts and interests in that behalf shall recommend them to the Institute.

SECTION 5. To be eligible to Active Membership, a person must be at least 26 years of age, and be an officer or other employee of a gas company; or a consulting expert in some branch of the gas industry. He must be competent to act efficiently as the Manager of a department of a Gas Company's business and must have his chief interest in the gas business directly connected with the manufacture, sale, or utilization of gas, and not the manufacture or sale of apparatus or appliances used by Gas Companies.

SECTION 6. To be eligible as a Junior Member, a person must be over 20 years of age and be in the employ of a Gas Company, or of a consulting expert in some branch of the gas industry, and must be qualified either by experience or education to hold a responsible position under such employers.

SECTION 7. To be eligible as an Associate Member, a person must be engaged in a pursuit which constitutes a branch of the gas industry, or be otherwise qualified to assist in promoting the objects of the Institute.

SECTION 8. Charter Members shall be such of the present membership of the American, Ohio, or Western Gas Association as shall be certified by the officers of the same to the Directors of the Institute as qualified respectively for Active, Junior or Associate Membership, provided that to become a

Charter Member, it shall be necessary for each person so certified to make application to the Directors of the Institute within a period of sixty days after notice has been sent him of the formation of the Institute.

ELECTION OF NEW MEMBERS.

SECTION 9. Candidates for Honorary Membership, if endorsed by not less than ten members of the Institute, in writing to the Board of Directors, shall be voted upon by the Board, and if receiving the unanimous vote of the Directors voting, shall be voted upon by the voting membership of the Institute not less than one year thereafter by a special mail ballot.

SECTION 10. Every application for either Active, Junior or Associate Membership shall be made to the Secretary in writing upon a form approved by the Directors, upon which shall be set forth as the grounds of the application a complete account of the qualifications and experience of the applicant and his agreement to conform, if elected, to the Constitution, By-Laws and Rules of the Institute. Each applicant must be endorsed by at least two Active members to whom he is personally known. The Secretary shall submit each application to the Membership Committee, who shall consider and act upon it and assign the applicant to the grade of membership to which, in their judgment, his qualifications entitle him. The name of each candidate thus approved by the Membership Committee, unless objection is made by the applicant, shall, after approval by the Directors, be submitted to the voting membership for election by means of a letter ballot.

SECTION 11. It shall be competent for any Junior or Associate Member to apply for transfer to another grade of membership. The application for such transfer shall be made in the same manner as in the case of a new applicant.

SECTION 12. Election to membership shall be by a sealed letter ballot as the By-Laws shall provide. Adverse votes to

the number of 2 per cent. of the votes cast shall defeat the election of an applicant for any grade of membership. The Directors may, in their discretion, order a second ballot upon a defeated applicant, in which case adverse votes to the number of 4 per cent. of the votes cast shall be required to defeat the election.

SECTION 13. Any person elected to the Institute, except Honorary Members, must subscribe to the Constitution and pay to the Treasurer the initiation fee and one year's dues for his grade of membership before he can be entitled to the rights and privileges, or can receive a certificate of membership. If this requirement is not complied with within six months of the notification of the election, the applicant shall be deemed to have declined the election and the election shall be void.

INITIATION FEES AND DUES.

SECTION 14. The initiation fee for membership in each grade shall be as follows:

For Active Members	$10.00
For Associate Members	10.00
For Junior Members	5.00

The initiation fees shall not include the dues for the current year in which the applicant is elected.

SECTION 15. A Junior Member, on promotion to any other grade of membership, shall pay an additional fee of $5.00, except that Charter Junior Members shall not be required to pay such additional fee. No person shall retain Junior Membership for more than two years after becoming qualified for Active Membership.

SECTION 16. The annual dues, payable in advance, for membership in each grade shall be as follows:

For Active Members	$15.00
For Associate Members	15.00
For Junior Members	7.50

SECTION 17. The Directors may in their discretion permit

any Active or Associate Member to become a Life Member in the same grade by the payment in one sum of an amount sufficient to purchase from a reputable life insurance company an annuity on the life of a person of the age of the applicant equal to the annual dues in his grade of membership. Such life member shall not be liable thereafter for annual dues.

SECTION 18. The Directors shall have power by letter ballot to admit to Life Membership, without payment of a Life Membership fee, any person who for a long term of years has been an Active or an Associate Member, when, for special reasons, such an action would, in their judgment, promote the best interests of the Institute. Notice that such action as proposed shall have been given at a previous meeting of the Directors, and one dissenting vote shall defeat the proposed action.

SUSPENSIONS AND EXPULSIONS.

SECTION 19. Any member may retire from membership by giving written notice to that effect to the Secretary, and paying all dues to date, unless released from said payment by a vote of the Directors. A member whose dues for a year completely expired are not paid, shall not be entitled to vote, nor to participate in the deliberations of the Institute, nor to receive a copy of the PROCEEDINGS. Any member whose dues shall remain unpaid for a term of three years may be dropped from the roll of membership by a vote of the Directors. A member dropped for non-payment of dues may, upon paying the amount he owes the Institute, be reinstated at the option of the Directors.

SECTION 20. The Directors may refuse to receive the dues of any member of any grade who shall have been adjudged by them to have violated the Constitution or By-Laws of the Institute, or who, in their opinion, shall have been guilty of conduct rendering him unfit to continue in its membership, and such person may be expelled from the Institute after notice

and hearing by the Directors upon unanimous vote of the Directors present.

SECTION 21. The Directors may transfer any member from his then present to any lower grade of membership. They may also refuse to receive the dues of any member who is no longer eligible to any grade. No transfer of grade shall be made, or refusal to accept dues recorded, except upon notice from the Secretary, whose duty it shall be to give such notice, that said member is no longer eligible for membership in his then present grade, and that said member has for a period of ninety days after notification of such non-eligibility, failed to apply for transfer. The vote in each case shall be by ballot, and shall require two-thirds of the votes cast for its adoption.

MANAGEMENT.

SECTION 22. The affairs of the Institute shall be managed by the Directors, subject to the control of the general meeting.

SECTION 23. The Board of Directors shall consist of the President, the Vice-Presidents, the Secretary, the Treasurer, the Junior Past-Presidents, and until changed as hereinafter provided for, ten Active Members of the Institute. Five members elected by the Institute shall constitute a quorum for the transaction of business. If arrangements are made for co-operation between the Institute and district and state gas associations, as hereinafter provided for, the number of members of the Board elected from the Active Members of the Institute shall be increased from time to time, as it becomes necessary, in order to keep the number of Directors elected by the Institute equal to not less than two-thirds of the total number of both Institute and Associate Directors.

SECTION 24. Should a vacancy occur in the Board of Directors or in any elective office, except the Presidency or First Vice-Presidency, through death, resignation or other cause, the Directors may elect an Active Member to fill the vacancy until the next annual election.

SECTION 25. The Directors shall regulate their own proceedings, and may, by resolution, delegate specific powers to an Executive Committee, or to any one or more of their members. No act of the Executive Committee, or of a delegate, shall be binding until it has been approved by a resolution of the Directors.

SECTION 26. The Board of Directors shall present at the annual meeting of the Institute a report verified by the President, Secretary and Treasurer, or by a majority of the members, which shall show the state of the finances of the Institute at the date of the report; the receipts and expenditures for the fiscal year immediately preceding; the names and places of residence of the persons who have been admitted to membership in the Institute during that year, and give an account of the action taken by the Directors upon matters coming before it and recommendations as to the action to be taken by the Institute. This report shall be filed with the records of the Institute, and an abstract of it shall be entered in the minutes of the proceedings of the annual meeting.

OFFICERS.

SECTION 27. At each annual meeting there shall be elected from among the Active Members a President, a Vice-President for each Section into which the Institute is at the time divided, a Secretary, a Treasurer, and until otherwise provided for, five members of the Board of Directors. All of the officers shall be elected for one year, but the members of the Board of Directors shall be elected for two years.

SECTION 28. All elections shall be by ballot.

SECTION 29. The term of all elected officers shall begin on the adjournment of the annual meeting of the Institute at which they were elected. Officers shall continue in their respective offices until their successors have been elected and have accepted such election.

SECTION 30. The President and the retiring Active Members of the Board of Directors shall not be eligible for reelection the following year.

SECTION 31. Previous to each annual meeting it shall be the duty of the Directors to appoint a nominating committee of five members, none of whom shall be a Director. It will be the duty of this nominating committee to present at the annual meeting a list of the Active Members and Directors whom they recommend as officers for the ensuing year. It must select the Vice-President for each section from three active members to be chosen by a majority vote of that Section at the preceding annual meeting.

SECTION 32. Twenty or more members entitled to vote may constitute themselves a special nominating committee with the same powers as the nominating committee appointed by the Directors.

SECTION 33. The Directors shall appoint from their own number immediately after the meeting at which they are elected a finance committee of three members.

SECTION 34. The President shall take the chair at all meetings of the Institute wherever the members meet as one body and of the Board of Directors. He shall be an ex-officio member of every committee and sub-committee. He shall determine to which general committee any matter shall be referred.

SECTION 35. In the absence of the President, one of the Vice-Presidents shall take the chair; if more than one Vice-President be present in the absence of the President, the Vice-President to preside shall be determined by lot, and in the absence of the President and Vice-Presidents, a Chairman shall be appointed by the Directors from among their own members. Each Vice-President shall be the presiding officer of the section for which he was designated on nomination. He shall be ex-officio member of each committee relating solely to the work of his section.

SECTION 36. The duties of the Secretary shall be to take minutes of all proceedings of the Institute and of the Board of Directors and to enter them in proper books for that pur-

pose. He shall conduct the correspondence of the Institute, read minutes and notices of all the meetings, and also such papers and communications as are considered in the absence of their authors, and perform whatever other duties may be required in the Constitution and By-Laws appertaining to this department. There shall also be a Secretary for each Section to be appointed by the Chairman of the Section, and with the same term of office. His duties shall be in general to assist in conducting the meetings of his Section.

SECTION 37. The duties of the Treasurer shall be to receive and keep all annual dues and funds of the Institute, to keep correct accounts of same, and pay all bills approved by the President and a member of the Finance Committee, and he shall make an annual report to be submitted to the Institute.

SECTION 38. The duties of the Finance Committee shall be to audit the books, accounts and statements of the Treasurer; to invest the funds of the Institute, and to care generally for the finances of the Institute, subject to the control of the Directors.

SECTION 39. The duties of the Directors shall be to have the general management of the affairs of the Institute, and to prepare for its meetings. No paper or report that has not had the approval of the Directors shall be read at any meeting of the Institute or any Section thereof.

The Directors shall have the power to appoint, from time to time, a Committee on Arrangements from among the members to assist the Board of Directors in arranging for the meetings of the Institute. The Directors shall have power to fill for the unexpired term, any vacancies occurring by death, or resignation, in their own number, or in the general committees. The Directors shall have power to provide for the voluntary division of the membership into two or more sections for the choice of sectional Vice-Presidents and for the hearing and discussion of papers and reports. The functions and powers of such sections shall be limited to the nomination of a Vice-President, the providing and consideration of papers

and reports, the reference to committees and to recommendations to the Institute or the Board of Directors. Any member of the Institute may attend the meeting of any section at any time. Any Active or Associate Member may vote on section matters in one section only, and to so vote must register as a voting member of such section. He may change this registration on one year's notice to the Secretary of the Institute.

Upon the written application to the Directors of any thirty members of the Institute asking for the creation of a new section, the Directors shall proceed to form the section applied for.

Any resolution, report or recommendation, that has not been considered and approved by the Directors, and that in the opinion of the Chair would have the effect of changing the policy of the Institute, or committing it to any new policy or opinion to which it had not theretofore been committed, should be referred, before adoption, to the Board of Directors, whose duty it shall be to report to the next regular meeting of the Institute upon such committal, if any, and its proper phrasing.

SECTION 40. There shall be two general committees, each reporting to the Board of Directors and responsible to the Board for such part of the work of the Institute as is delegated to it in accordance with the provisions of Sections 34, 41 and 42. Each committee shall be composed of at least six members, appointed each year by the President-elect, and serve one year.

SECTION 41. One general committee shall be called the Public Relations Committee, and to it shall be referred all investigations, reports, recommendations, resolutions and matters of any kind affecting the relations between the Institute, or its members, and the public, or any governing bodies, except as herein provided.

SECTION 42. One general committee shall be called the Technical Committee, and to it shall be referred all investi-

gations, reports, recommendations, resolutions and matters of any kind having to do with the construction, operation and extension of gas works, and the conduct of the affairs of gas companies, not specifically delegated to the Public Relations Committee by Section 41, and except as herein otherwise provided. Each section shall have a representative on this Committee.

SECTION 43. Each general committee shall have the power to appoint sub-committees. Any sub-committee may be appointed from the general membership of the Institute, and shall exist at the pleasure of the general committee by which it was appointed, and to which its report shall be made.

MEETINGS AND PROCEEDINGS.

SECTION 44. The annual meeting of the Institute shall be held on the third Wednesday of October of each year, at such place as shall be designated by the Institute at the previous meeting. In case of emergency, the Directors shall have the power to change the time or place of meeting, or both, as so designated, by a three-fourths vote of all its members, at the call of the President, and such vote may be taken by mail.

SECTION 45. The Secretary shall send notices to all members of the Institute at least fourteen days before each general meeting, mentioning the papers to be read and any special business to be brought before the meeting. During a recess in any meeting of the Institute, taken in order that section meetings may occur, no meeting of the Institute other than as provided at the time the recess is ordered shall be held until one hour after a call for such meeting has been read in each section meeting at the time in session, and has been posted on the official bulletin board. The President shall have the authority to issue such call, and it shall be obligatory on him to issue such call on the written request of fifty members.

SECTION 46. Special meetings of the Institute may be called at the option of the Directors, and the Secretary shall call a special meeting on the written request of one hundred members.

The notices for special meetings shall be sent to all members at least three weeks before the date for which the meeting is called, and shall state the business to be transacted, and no other shall be entertained.

SECTION 47. Thirteen members shall constitute a quorum.

SECTION 48. All questions, except as otherwise provided in Sections 9, 20, 28, 49 and 57, shall be decided by any convenient system of open voting, the presiding officer to have a second or casting vote when necessary.

SECTION 49. Questions of a personal nature shall be decided by ballot and all parliamentary procedure not specifically covered by this Constitution shall be governed in accordance with Roberts' Rules of Order.

SECTION 50. Any member, with the concurrence of the presiding officer, may admit a friend to each meeting of the Institute, but such person shall not take part in any of the discussions unless permission to do so be given by the meeting.

SECTION 51. All papers read at the meetings of the Institute must relate to matters, either directly or indirectly connected with the objects of the Institute, and must be approved by the Directors before being read.

SECTION 52. All papers, drawings or models submitted to the meetings of the Institute shall be and remain the property of the authors.

SECTION 53. The President, the Junior Past-President, the First Vice-President, the Junior Past-Chairmen of the two general committees, and the Secretary shall constitute a Publication Committee, and nothing shall be included in the published reports of the Institute's PROCEEDINGS, or in any other publication issued by its authority, that has not been approved by at least two-thirds of the full membership of the Publication Committee.

SECTION 54. The Directors shall meet the day before each general meeting of the Institute, and also on such day between June 1st and September 15th, both inclusive, as may

be designated by the President, by notice given at least one week in advance of meeting. Special meetings may be called when the President shall deem it necessary, and the President shall be required to call a special meeting at any time on the written request of five members of the Board. Of such meetings reasonable notice shall be given by special call, in print or writing, specifying the business to be attended to.

GEOGRAPHIC AND DISTRICT SECTIONS.

SECTION 55. A. The Board of Directors may in its discretion make with any gas, electric, or gas and electric association an affiliation agreement upon such terms as may be mutually agreed upon, provided the membership or objects or interest of such association are not in conflict with those of the Institute. An affiliation agreement shall provide for the termination of such agreement on twelve months' notice by either party.

An affiliation agreement may provide for representation of the affiliated association on the Board of Directors of the Institute; but in such case said association shall at no time have more than 20 per cent. of its voting membership persons not directly identified with gas or electric interests within the state or district designated by the name of the association; and said association shall agree to present the result of work of interest in the form of a report to the Board of Directors of the Institute; such affiliated Associate Directors shall be additional to the Institute Directors provided for in Section 23, and shall at no time exceed one-third of the total.

B. The Board of Directors may in its discretion authorize the formation of geographic sections. The territory to be included in each section shall consist of a state, or group of states.

C. Subject to the approval of the Board of Directors of the Institute and the governing body of the geographic section in which it is located, city or district sections may be formed.

D. The geographic and city or district sections may adopt

such constitutions and by-laws and elect such officers as they see fit, provided that nothing shall be done in violation of the Constitution and By-Laws of the American Gas Institute.

E. After giving due notice, any section may send a representative to appear before the Board of Directors of the Institute for the purpose of conferring with the Board in regard to any matters relating to the affairs of the Institute in the territory embraced by the section.

F. The Secretary of the section shall report its proceedings to the Secretary of the Institute.

G. No person shall be eligible for membership in any section who is not a member of the American Gas Institute.

H. Sections may be dissolved for failure to comply with the Constitution and By-Laws of the Institute.

PROCEEDINGS.

SECTION 56. Each member of the Institute in good standing shall be entitled to and shall be furnished by the Secretary with a copy of the PROCEEDINGS of the Institute for the current year, in which shall be listed the names and addresses of the members. In any such list, each member should be listed by the title, or titles, only, from which he derives his eligibility to his class of membership.

AMENDMENTS.

SECTION 57. All propositions for adding to or altering any of the provisions of the foregoing Constitution shall be laid before the Directors, who, if they see fit, may bring it before the next general meeting of the Institute, and who shall be bound to do so on the requisition in writing of any ten members of the Institute. All such propositions shall be decided by ballot and shall require two-thirds of the vote cast for their adoption.

BY-LAWS

(Section numbers refer to corresponding Sections of the Constitution.)

1. (Section 10.) Each member proposing a candidate for admission is required to make a confidential communication to the Secretary for forwarding to the Membership Committee, setting forth in detail such information, personally known to referee, as shall enable the Directors to decide upon the eligibility of the candidate for admission to the Institute, except that in the event of the requisite number of members in good standing having personally signed the application of a candidate, this may be deemed sufficient endorsement, and the requirement of the confidential communication referred to above shall not be obligatory, but shall be optional at the discretion of the Membership Committee. The Secretary shall be the judge of the competency and the signature of referees.

2. (Section 10.) In the absence of replies from the referees to inquiries for information, or if replies are not sufficiently explicit, the Secretary shall cause the applicant to be notified, and the application shall be held in abeyance.

3. (Section 10.) At a meeting subsequent to their election, the Directors shall appoint from their number, four, to be a committee on election of new members. This committee shall pass on all applications for membership, and report to the Directors. Any correspondence in regard to an applicant shall be destroyed when his name has been placed upon a voting ballot, or upon withdrawal of the application.

4. (Section 12.) The Secretary shall, twice a year, on or about the first day of March and September, mail to each member entitled to vote, a ballot stating the names and respective grades of the candidates for membership in the Institute which have been approved by the Directors, and the time of the close of voting. The voter shall prepare his ballot by crossing out the names of candidates rejected by him, and shall enclose said ballot in a sealed blank ballot envelope, which he shall then enclose in a second sealed outer envelope

on which he shall, for identification, write his name in ink. The ballot thus prepared and enclosed shall be mailed or delivered unopened to the Secretary, which shall be counted as an affirmative vote on all the names not crossed out. The Secretary shall be the judge of the competency and the signature of all voters. On the close of the voting, the Secretary shall first open and destroy the outer envelopes, and shall then canvass the ballots, and certify the result to the Membership Committee.

The Secretary shall not receive any ballot after the stated time of the close of voting. A ballot without the endorsement of the voter, written in ink on the outer envelope, shall be considered as defective, and rejected by the Secretary.

The names of those persons elected to membership, with their respective grades, shall be embodied in a written report, signed by the Secretary, and presented to the next meeting of the Institute. The President shall then declare them duly elected to membership in the Institute. The Secretary may, in advance of any meeting, advise each candidate of the result of the canvass of the votes in his case. The names of applicants who are not elected shall neither be announced nor recorded in the PROCEEDINGS.

The endorser of an applicant who has not been elected, may, with his consent, present to the Directors a written request for a re-submission of his name to ballot. The Directors may, in their discretion, by a three-fourths vote of the members present, order the name of the applicant placed on the next ballot for members.

5. (SECTION 13.) Section 13 of the Constitution shall be printed upon the notification of election to all members except Honorary Members.

6. (SECTIONS 14 and 16.) The initiation fee and annual dues of the first year shall be due and payable on notice of election to membership. Bills for the fee and dues should accompany the notification of election. Thereafter the annual

dues shall be due and payable on the first day of September of each year.

7. (SECTIONS 14 and 16.) Upon payment of the initiation fee and annual dues, a newly elected member shall receive copies of any publications of the Institute, which may have been distributed without charge to the members during that year, even though the date of issue of these publications is prior to that of the election of such member.

8. Each member shall be entitled to a badge upon payment of an amount to be fixed from time to time by the Directors. Upon his ceasing to be a member, he shall return his badge, and receive therefor the sum of $2.00.

9. Each member shall be entitled to a certificate of membership in accordance with his grade, signed by the President and Secretary. Every such certificate shall remain the property of the Institute, and shall be returned to the Secretary on demand of the Directors.

10. (SECTION 19.) The Treasurer shall present to the Directors the name of any member in arrears for more than one year.

11. (SECTION 20.) At least one month's notice shall be given to the Directors and to the member who is to be heard.

12. (SECTION 26.) The Secretary shall furnish the Directors with the information needed for their annual report, excepting only as to finances, or to matters which have been entrusted to special committees. The financial report shall be made by the Treasurer to the Finance Committee.

13. (SECTION 26.) The fiscal year of the Institute shall begin September 1st.

14. (SECTION 28.) The President shall, at the first session of the Annual Meeting, appoint three Tellers of Election, who shall canvass the vote cast for officers, and report the result to the meeting.

15. (SECTION 31.) The Nominating Committee shall report at the first session, and a ballot be taken on their report

at once unless twenty or more members object. In such case, the ballot for officers shall take place at the first session of the second day, in the manner prescribed in By-Law No. 15.

16. (Section 31.) If the report of the Nominating Committee is not unanimously adopted, the Tellers of Election shall distribute ballots among the members at once, unless the election is postponed, as covered by By-Law No. 14. In either case, poll may be opened outside the meeting room in some adjacent and convenient place. If there is no objection, one ballot may be cast for those nominated by the committee.

17. (Section 33.) When the appointment of a chairman is not included in the appointment of a committee, the latter shall elect their own chairman.

18. (Section 36.) The Secretary shall be in charge of the membership lists. He shall also be in charge of all other property of the Institute not distinctly pertaining to the Treasurer's work.

19. (Section 37.) The annual report of the Treasurer shall be embodied in the financial report of the Directors.

20. (Section 37.) Neither the Treasurer nor any other officer of the Institute shall pay out money except upon bills approved by the President and a member of the Finance Committee.

21. (Section 37.) The Treasurer shall furnish a bond for the faithful performance of his duties to such amount as the Finance Committee may require, such bond to be procured from an incorporated gurantee company at the expense of the Institute.

22. (Section 39.) The President, subject to subsequent approval by the Directors, may, in his discretion, appoint a member or members of the Institute to represent it at meetings of associations of kindred aim or at public functions. Such delegates should be designated as "Honorary Vice-Presidents," and their duties shall terminate with the occasion for which they are appointed.

23. (SECTION 39.) Not later than six months prior to each annual meeting of the Institute, the Directors shall appoint an Arrangement Committee to have charge of all the details connected with the annual meeting, except only as to papers.

24. (SECTION 39.) The voting lists for section matters shall be drawn up from the list of members as published in the last volume of the PROCEEDINGS, in which the section registration of each member shall be shown.

25. At the opening of the first session, following the election of officers, the President shall appoint a committee of three to recommend the place to be designated by the Institute for the next annual meeting.

26. (SECTION 57.) Amendments of, or additions to, the By-Laws may be adopted by the Directors by a unanimous vote at any meeting. When objection is made, two weeks' notice and copy of the proposed changes shall be sent to each Director. At any meeting subsequent to such notice, a two-thirds vote will be sufficient for adoption.

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Past Officers of the Merged Associations

AMERICAN GAS LIGHT ASSOCIATION

1873–1906

Past Presidents

*Charles Roome	1873-79	Arthur E. Boardman	1893
*William H. Price	1880-81	William H. Pearson	1894
*Andrew Hickenlooper	1882	Walton Clark	1895
*Theobald Forstall	1883	C. J. R. Humphreys	1896
*William A. Stedman	1884	Chas. H. Nettleton	1897
*Eugene Vanderpool	1885	*J. B. Crockett	1898
*Austin C. Wood	1886	Alex. C. Humphreys	1899
Malcolm S. Greenough	1887	Geo. G. Ramsdell	1900
*Thomas Turner	1888	Edward G. Pratt	1901
*Alpheus B. Slater	1889	*Wm. R. Beal	1902
Emerson McMillin	1890	Alten S. Miller	1903
*John B. Harbison	1891	Rollin Norris	1904
*William Henry White	1892	E. G. Cowdery	1905
[1]*Charles F. Prichard	1906		

Past Secretaries

*Henry Wurtz	1873	C. J. R. Humphreys	1884-91
*Peter E. Demill	1874	A. B. Slater, Jr	1892-96
*Charles H. Nettleton	1875-79	Alfred E. Forstall	1897-04
*William Henry White	1880-83	Geo. G. Ramsdell	1905-06

OHIO GAS LIGHT ASSOCIATION

1884–1906

Past Presidents

*Gen. A. Hickenlooper	1884-86	Jerome Penn	1897
Emerson McMillin	1887	W. C. Boyle	1898
Eugene Printz	1888	*B. P. Holmes, elected for	1899
*Thomas Wood	1889	*E. H. Jenkins	1899
Edw. Lindsley	1890	A. P. Lathrop	1900
*Chas. R. Faben, Jr	1891	George Whysall	1901
*H. Wilkiemeyer	1892	Henry L. Doherty	1902
Chas. H. Welch	1893	C. W. Andrews	1903
Irvin Butterworth	1894	John D. McIlhenny	1904
J. W. R. Cline	1895	F. W. Stone	1905
*Jos. Gwynn	1896	Donald McDonald	1906
[1]B. W. Perkins	1907		

[1] Elected but did not serve owing to merger. * Deceased.

OHIO GAS LIGHT ASSOCIATION–(*Continued*)

Past Secretaries

*Joseph M. Bate 1884-85
Irvin Butterworth....1886-93
A. P. Lathrop 1894-98
Thomas Clive Jones..1899-1906

WESTERN GAS ASSOCIATION

1878–1906

Past Presidents

*J. O. King.....1878-80
*Thomas Butterworth..1881-82
*J. B. Howard.....1883-84
T. G. Lansden..... 1885
*James Somerville..... 1886
*John Fullagar..... 1887
Emerson McMillin 1888
George G. Ramsdell .. 1889
*E. G. King, Elected for . 1890
*Charles R. Faben, Jr.. 1890
Frederic Egner 1891
E. G. Cowdery..... 1892
*B. E. Chollar..... 1893
*E. H. Jenkins..... 1894
Isaac C. Baxter..... 1895
A. W. Littleton 1896
*W. H. Odiorne..... 1897
James T. Lynn 1898
*G. Treadway Thompson 1899
William McDonald.... 1900
I. C. Copley..... 1901
Thomas D. Miller..... 1902
A. H. Barret..... 1903
F. H. Shelton 1904
O. O. Thwing 1905
Paul Doty..... 1906
[1]*Kerr Murray Mitchell..... 1907

Past Secretaries

*Lee A. Hall 1878-82
A. W. Littleton 1882-94
James W. Dunbar 1895-1906

AMERICAN GAS INSTITUTE

Past Presidents

B. W. Perkins..... 1906
Walton Clark.....1906-1907
Alex. C. Humphreys.1907-1908
*Chas. F. Prichard...1908-1909
W. H. Bradley.....1909-1910
Donald McDonald...1910-1911
Ira C. Copley.....1911-1912
W. R. Addicks 1912-1913
W. H. Gartley 1913-1914

Past Secretaries

James W. Dunbar....1906-1908
A. B. Bradle.....1908-1911
Geo. G. Ramsdell....1911-

[1] Elected but did not serve owing to merger. * Deceased.

MEMBERS

OF THE

AMERICAN GAS INSTITUTE

HONORARY MEMBERS.

BONÉ, PROF. WILLIAM A., September, 1912.
Professor in the Imperial College of Science and Technology, South Kensington, London, S. W., England.

CHANDLER, CHARLES F., PH. D., M. D., LL. D., D. Sc., September, 1910.
51 East 54th Street, New York, N. Y.

KING, WILLIAM, September, 1910.
5 Beach Lawn, Waterloo, Liverpool, England.

WOODALL, SIR CORBET, September, 1910.
Palace Chambers, Bridge Street, Westminster, S. W., London, England.

LIFE MEMBER.

SLATER, ALPHEUS B., October, 1906.
Consulting Engineer, Slocums, Rhode Island.

ACTIVE MEMBERS.

ABELL, H. C., October, 1906. (P)
Chief Engineer, American Light & Traction Company, 40 Wall Street, New York, New York.

ADAMS, B. C., October, 1906.
Care Byington & Co., Sao Paula, Brazil, South America.

ADAMS, H. C., October, 1906.
Vice-President, Westmoreland Coal Company, 224 South Third Street, Philadelphia, Pennsylvania.

ADAMS, OLIVER WINCHESTER, September, 1914. (N) (P)
Superintendent, Holyoke Gas Works, City Hall, Post Office Box 218, Holyoke, Massachusetts.

ADAMS, ROBERT MORFORD, March, 1913.
Secretary and Treasurer, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

P = Present.
N = Elected in 1914.

ADDICKS, WALTER R., October, 1906. (P)
Vice-President, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

AFRICA, WALTER G., October, 1906. (P)
Treasurer and Manager, Peoples Gas Light Company, 39 Hanover Street, Manchester, New Hampshire.

ALDEN, JOHN DOUGLAS, March, 1910. (P)
Assistant, Bronx Gas & Electric Company, 1520 Overing Street, Westchester, New York.

ALLEN, ARTHUR BENJAMIN, March, 1914. (N) (P)
Assistant Superintendent, New York Mutual Gas Light Company, 825 East 11th Street, New York, New York.

ALLEN, WILLIAM H., JR., September, 1909.
Superintendent, By-Products Coke Corporation, Semet-Solvay Coke Ovens, South Chicago, Illinois.

ALLISON, WALTER A., October, 1906. (P)
Engineer, 403 Wister Street, Philadelphia, Pennsylvania.

ALLYN, GEORGE E., October, 1906.
Superintendent of Distribution, Providence Gas Company, 20 Market Square, Providence, Rhode Island.

ALMBERG, H. E., September, 1913. (P)
Attorney for Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

ALRICH, HERBERT W., March, 1909. (P)
Assistant Engineer of Construction, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

ALTHEN, GEORGE R., September, 1912. (P)
General Superintendent of Distribution, Gas Division, Consolidated Gas, Electric Light & Power Company, 1068 North Front Street, Baltimore, Maryland.

ALTHOUSE, A. J., September, 1912.
Superintendent, Hamburg Gas & Electric Company, Hamburg, Pennsylvania.

AMBLER, THOMAS MARSHALL, September, 1914. (N) (P)
Manager, Commercial Department, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

AMES, KNOWLTON L., October, 1906.
Jacksonville Gas Company, 108 South La Salle Street, Chicago, Illinois.

ANDERSON, HOWARD BRUCE, September, 1911. (P)
Superintendent City District, The United Gas Improvement Company, 1931 South 9th Street, Philadelphia, Pennsylvania.

ANDERSON, WILLIAM C., October, 1906. (P)
Bertron, Griscom & Company, Wilkes-Barre, Pennsylvania.

ANDREWS, CHARLES HAROLD, March, 1912.
Assistant General Manager, North Carolina Public Service Company, Greensboro, North Carolina.

ANDREWS, C. W., October, 1906. (P)
Treasurer, Zenith Furnace Company, 404 West First Street, Duluth, Minnesota.

ANDREWS, J. CHARLES, October, 1906.
Turner Construction Company, 11 Broadway, New York, New York.

ANGELL, FREDERIC J., September, 1908.
Mechanical Engineer, 38 Victoria Street, Westminster, London, S. W., England.

ARKWRIGHT, P. S., October, 1906.
Vice-President, Atlanta Gas Light Company, Electric & Gas Building, Atlanta, Georgia.

ARMSTRONG, H. V., March, 1912.
Engineer, Northern Indiana Gas & Electric Company, Michigan City, Indiana.

ARMSTRONG, J. H. N., March, 1911. (P)
Statistician, Consolidated Gas Company, 130 East 15th Street, New York, New York.

ASHWORTH, JAMES, September, 1910. (P)
Superintendent of Distribution, Public Service Gas Company, St. Paul and St. James Avenues, Jersey City, New Jersey.

ATWOOD, C. CASSELS, October, 1906.
Superintendent, New Amsterdam Gas Company, Vernon and Webster Avenues, Long Island City, New York.

AYRES, CHESTER T., September, 1908.
Works Manager, Union Carbide & Electro-Metallurgical Company, 30 East 42d Street, New York, New York.

BAEHR, WILLIAM ALFRED, October, 1906. (P)
Consulting Engineer, Peoples Gas Building, Chicago, Illinois.

BAIN, FERDINAND R., September, 1914. (N)
President, Southern Counties Gas Company, 616 Title Insurance Building, Los Angeles, California.

BAINS, GEORGE B., 3D, October, 1906. (P)
Engineer, Consumers Gas Company, 441 Penn Street, Reading, Pennsylvania.

Ball, James, October, 1906.
Assistant Secretary and Treasurer, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Ball, Samuel, September, 1911.
Manager, Bay City Gas Company, 520 Centre Avenue, Bay City, Michigan.

Barker, Perry, September, 1911.
Fuel Engineer, Arthur D. Little, Inc., 93 Broad Street, Boston, Massachusetts.

Barker, William S., September, 1911. (P)
Assistant to Comptroller, Public Service Gas Company, 763 Broad Street, Newark, New Jersey.

Barlow, Thaddeus Scott, September, 1910. (P)
Superintendent, Consolidated Gas Company, 302 East 99th Street, New York, New York.

Barnes, Albert Mallard, September, 1907. (P)
President and General Manager, Cambridge Gas Light Company, 719 Massachusetts Avenue, Cambridge, Massachusetts.

Barnitz, Frank H., September, 1908. (P)
Assistant Secretary, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Barnum, Dana Dwight, March, 1911.
General Manager, Worcester Gas Light Company, 240 Main Street, Worcester, Massachusetts.

Barret, A. H., October, 1906.
Retired, Louisville Gas Company, 5 Board of Trade Building, Louisville, Kentucky.

Barrett, William E., October, 1906. (P)
Gas Engineer, Room 1902, 43 Exchange Place, New York, New York.

Barrett, William Felton, September, 1908.
Consulting Engineer, 42d Street Building, 30 East 42d Street, New York, New York.

Barrows, George S., October, 1906. (P)
Engineering Department, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Barthold, W. H., October, 1906. (P)
Gas Engineer, Hodenpyl, Hardy & Company, 14 Wall Street, New York, New York.

Batten, J. W., March, 1909. (P)
Engineer, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Battin, Henry S., October, 1906.
Assistant to General Superintendent, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Battin, Isaac, October, 1906.
Retired, Engineer, Omaha Gas Company, 710 Wyandotte Avenue, Lafayette, Indiana.

Battin, Wm. Ingram, March, 1910.
Engineer, Indiana Lighting Company, 911 Pontiac Street, Lafayette, Indiana.

Baurhyte, William, October, 1906.
Vice-President, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Baxter, Isaac C., October, 1906.
Upland, San Bernardino County, California.

Bayly, C. Clay, October, 1906. (P)
Assistant to Engineer, Washington Gas Light Company, 413 Tenth Street, N. W., Washington, District of Columbia.

Beadenkopf, George, October, 1906. (P)
Engineer, Consolidated Gas, Electric Light & Power Company, Lexington and Liberty Streets, Baltimore, Maryland.

Beadle, Albert B., October, 1906.
Consulting Gas Engineer, 1328 Chestnut Street, Philadelphia, Pennsylvania.

Beal, A. R., October, 1906. (P)
Contract Agent, Central Hudson Gas & Electric Company, 129 Broadway, Newburgh, New York.

Beal, T. R., October, 1906. (P)
President, Central Hudson Gas & Electric Company, 50 Market Street, Poughkeepsie, New York.

Beaumont, Walter W., September, 1907. (P)
Superintendent of Transportation, The United Gas Improvement Company, 4650 Market Street, Philadelphia, Pennsylvania.

Becher, Eugen, March, 1913.
Chief Engineer, Blaugas Company of America, 25 Madison Avenue, New York, New York.

Beck, George W., October, 1906.
Superintendent, Northumberland County Gas & Electric Company, Sunbury, Pennsylvania.

Bell, Ernest William, October, 1906.
Consulting Engineer, Room 1425, 165 Broadway, New York, New York.

Benedict, Clarence M., September, 1908.
Assistant Secretary and Treasurer, Charleston Consolidated Railway & Lighting Company, Charleston, South Carolina.

Bennett, Charles W., October, 1906. (P)
General Manager, Binghamton Gas Works, 40 Chenango Street, Binghamton, New York.

Bennett, Orville Grant, March, 1914. (N) (P)
Assistant Treasurer, Northern Westchester Lighting Company, 127 Main Street, Ossining, New York.

Benson, Frederick Shepard, Jr., March, 1911. (P)
Superintendent, Nassau Works, Brooklyn Union Gas Company, 556 Kent Avenue, Brooklyn, New York.

Berkley, Jos. M., October, 1906.
Superintendent and Engineer, Southern California Edison Company, Edison Building, Los Angeles, California.

Bertke, W. A., September, 1909.
Superintendent, Gas Plants, Pacific Power & Light Company, North Yakima, Washington.

Bertke, William John, October, 1907.
Engineer, Sioux City Gas & Electric Company, 3519 Jackson Street, Sioux City, Iowa.

Bertrand, Philip A., October, 1906.
General Manager, Grays Harbor Railway & Light Company, Aberdeen, Washington.

Beugler, Hugh M., September, 1913. (P)
Operating Manager, Central Hudson Gas & Electric Company, 50 Market Street, Poughkeepsie, New York.

Bill, Benjamin P., October, 1906.
Superintendent, Springfield Gas Light Company, 23 State Street, Springfield, Massachusetts.

Bimson, John, Jr., September, 1909. (P)
Superintendent Distribution, Public Service Gas Company, East 5th Street, Paterson, New Jersey.

Bird, Viggo Edward, September, 1910.
Manager, New London Gas & Electric Division, Connecticut Power Company, 33 Union Street, New London, Connecticut.

Bishop, Rookwood Comfort, March, 1911.
General Manager, Christchurch Gas, Coal & Coke Company, Ltd., 77 Worcester Street, Christchurch, New Zealand.

Bissell, West, October, 1906.
Civil Engineer, Care of Mrs. Kennedy, 27 Park Street, Jersey City, New Jersey.

Blackie, John F., March, 1911.
Assistant Superintendent, Milwaukee Coke & Gas Company, Milwaukee, Wisconsin.

Blackwell, Hubert C., September, 1912. (P)
General Superintendent, Peoples Light Company, 125 West 3d Street, Davenport, Iowa.

Blauvelt, William Hutton, March, 1911.
Consulting Engineer, Semet-Solvay Company, Syracuse, New York.

Blauvelt, Warren S., October, 1906. (P)
Superintendent, Detroit Plant, Delray Station, Semet-Solvay Company, Post Office Box 11, West Jefferson and Solvay Avenues, Detroit, Michigan.

Blowers, Frank W., October, 1906.
Secretary and General Manager, Kalamazoo Gas Company, Kalamazoo, Michigan.

Boardman, A. E., October, 1906.
Villa Canto Sereno, Locarno, Minusio, Switzerland.

Bodine, Samuel Taylor, October, 1906.
President, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Bogert, W. Russell, March, 1911. (P)
Representative, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Bond, Charles O., March, 1907. (P)
Manager, Photometrical Laboratory, The United Gas Improvement Company, 3101 Passyunk Avenue, Philadelphia, Pennsylvania.

Boone, Charles, October, 1906. (P)
Engineer, Metropolitan Works, Brooklyn Union Gas Company, 12th Street and Gowanus Canal, Brooklyn, New York.

Booth, Arthur, September, 1909.
Assistant General Purchasing Agent, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

Booth, W. F., March, 1909.
Manager, Little Rock Gas & Fuel Company, 113 West 6th Street, Little Rock, Arkansas.

Borden, Albert Wells, September, 1914. (N)
Vice-President and Manager, The Hastings Gas Company, 302 Lincoln Avenue, Hastings, Nebraska.

Borgner, Cyrus, October, 1906. (P)
President, Cyrus Borgner Company, 234 North Twenty-third Street, Philadelphia, Pennsylvania.

Boyd, Albert Matthew, October, 1906. (P)
Assistant to General Superintendent, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Bradley, Charles W., October, 1906. (P)
Gas Engineer, Public Service Company of Northern Illinois, 72 West Adams Street, Chicago, Illinois.

Bradley, Wallace H., September, 1914. (N)
Manager, Springfield Gas Light Company, Springfield, Massachusetts.

Bradley, William H., October, 1906. (P)
Chief Engineer, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Brady, James C., March, 1907.
Director, New Amsterdam Gas Company, 54 Wall Street, New York, New York.

Brady, John T., October, 1906.
Treasurer, Denver Gas & Electric Company, 900 Fifteenth Street, Denver, Colorado.

Braine, John H., October, 1906. (P)
Superintendent, Holder Distribution Department, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Brewer, Joseph H., September, 1912.
Vice-President, Kelsey & Brewer Company, Michigan Trust Building, Grand Rapids, Michigan.

Britsch, Mathias, October, 1906.
Superintendent, Cicero Station, Public Service Company of Northern Illinois, Lombard Avenue and G. W. Tracks, Oak Park, Illinois.

Britton, John A., October, 1906.
Vice-President and General Manager, Pacific Gas & Electric Company, 445 Sutter Street, San Francisco, California.

Britton, Van Leer Eastland, September, 1914. (N)
Gas Engineer, 454 California Street, San Francisco, California.

Brodnax, Wm. F., October, 1907.
14 Eighth Avenue, Bethlehem, Pennsylvania.

Brown, Charles H., September, 1912.
Superintendent, Suffolk Gas-Electric Company, 1003 West Washington Street, Suffolk, Virginia.

Brown, Ernest C., October, 1906. (P)
Secretary and Treasurer, Boone (Iowa) Gas Company, Editor *The Gas Age,* 280 Broadway, New York, New York.

Brown, James A., September, 1911.
Gas Engineer, Commonwealth Power Company, 214 West Main Street, Jackson, Michigan.

Brown, R. B., October, 1906. (P)
General Manager and Chief Engineer, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

Brown, Robert E., October, 1906.
General Manager, Consumers Power Company, 132 South Front Street, Mankato, Minnesota.

Brown, Samuel W., September, 1910.
Superintendent, Gas Department, Columbia Railway, Gas & Electric Company, 2805 Wilson Street, Columbia, South Carolina.

Bruce, Howard, October, 1906. (P)
Vice-President, The Bartlett Hayward Company, Continental Building, Baltimore, Maryland.

Bruff, Charles L., March, 1911.
Combustion Engineer, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Brundage, Henry M., September, 1908. (P)
Assistant Secretary, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Brundrett, Ernest L., October, 1906.
President, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

Brush, Daniel Harmon, Jr., March, 1912.
Superintendent, Calumet Division, Peoples Gas Light & Coke Company, 9555 Houston Avenue, Chicago, Illinois.

Bryans, Henry Bussell, March, 1908.
Engineer, Counties Gas & Electric Company, Norristown, Pa.

Bryant, Charles F., October, 1906. (P)
Auditor, Westchester Lighting Company, 1st Avenue and 1st Street, Mount Vernon, New York.

Buck, H. M., October, 1906.
Post Office Box 492, Waukesha, Wisconsin.

Buckley, Martin F., March, 1913. (P)
Foreman, Consolidated Gas Company, 501 East 21st Street, New York, New York.

BUCKMINSTER, ROLLIN, September, 1908.
Manager, Commercial Department, Fall River Gas Works Company, Fall River, Massachusetts.

BULL, DAVID M., September, 1913. (P)
Assistant Superintendent, Consolidated Gas Company, 99th Street and 2nd Avenue, New York, New York.

BULLARD, JOHN ERVIN, March, 1913. (P)
Manager, New Business Department, Public Service Corporation of Long Island, Port Washington, New York.

BULLOCK, B. F., October, 1906.
Superintendent, City Gas Works, Municipal Plant, Fredericksburg, Virginia.

BUNKER, THEODORE, October, 1906. (P)
Engineer, Gas Department, Passaic Division, Public Service Gas Company, East 5th Street Gas Works, Paterson, New Jersey.

BURCOMBE, NORMAN SMITH, March, 1911.
Manager, Grays Harbor Gas Company, 210 South Broadway, Aberdeen, Washington.

BURGESS, C. F., October, 1906.
Northern Chemical Engineering Laboratories, Madison, Wisconsin.

BURGI, HERMAN, October, 1906. (P)
General Superintendent, Gas Light Company, State and Water Streets, Springfield, Massachusetts.

BURKE, JOHN EDWARD, March, 1914. (N)
Superintendent of Distribution, Buffalo Gas Company, 28 East Glenwood Avenue, Buffalo, New York.

BURKHART, HENRY W., March, 1910.
Consulting Gas Engineer, 913 International Bank Building, Los Angeles, California.

BURLEIGH, JOHN J., September, 1907.
Second Vice-President, Public Service Gas Company, 418 Federal Street, Camden, New Jersey.

BURNS, JOHN J., March, 1914. (N)
Superintendent, Commercial Department, Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

BURRITT, DWIGHT F., September, 1907.
General Superintendent, National Gas, Electric Light & Power Company, 1714 Ford Building, Detroit, Michigan.

BURT, AUSTIN, October, 1906.
Manager, Citizens Gas & Electric Company, 308 East 4th Street, Waterloo, Iowa.

BUSH, ROBERT WILDER, October, 1906. (P)
Engineer of Manufacture, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

BUTLER, JOHN MORRIS, September, 1913. (P)
Secretary and Treasurer, Bronx Gas & Electric Company, Westchester, New York.

BUTTERWORTH, C. W., October, 1906.
Care Gas Company, Rockford, Illinois.

BYRNE, EDWARD J., October, 1906. (P)
Engineer of Citizens Works, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

BYRNE, EDWARD LOUIS, September, 1910. (P)
Superintendent, Fulton Works, The Brooklyn Union Gas Company, 265 Nevins Street, Brooklyn, New York.

BYRNE, THOMAS E., October, 1906.
Chief Engineer and General Manager, Kings County Lighting Company, 4802 New Utrecht Avenue, Brooklyn, New York.

CABELL, JOHN L., September, 1908.
Cabell & Peek, 120 Bay Street East, Savannah, Georgia.

CABOT, JOHN, October, 1906.
President, Cabot Manufacturing Company, 1421 Clinton Street, Hoboken, New Jersey.

CADWALLADER, L. L., October, 1906.
Superintendent, Kennebec Gas & Fuel Company, Waterville, Maine.

CAFFREY, GEORGE HENRY, March, 1913.
With Gas & Electric Company, Abilene, Texas.

CAHILL, WILLIAM J., October, 1906. (P)
General Manager, Gas Department, Utica Gas & Electric Company, 222 Genesee Street, Utica, New York.

CALHOUN, ERVIN, September, 1913. (P)
Superintendent of Stores, Philadelphia Gas Works, United Gas Improvement Company, 19th Street and Allegheny Avenue, Philadelphia, Pennsylvania.

CALKINS, WILLIAM BARTLETT, March, 1914.
Chemist, Fuel Testing Company, 220 Devonshire Street, Boston, Massachusetts.

CALLENBACH, DR. J. ANTON, October, 1906.
Chemical Engineer, Clinchfield Fuel Company, 134 St. John Street, Spartanburg, South Carolina.

CALLENDAR, ELBERT P., October, 1906. (P)
President, *American Gas Light Journal,* Inc., 42 Pine Street, New York, New York.

CAMPBELL, ALEX. J., October, 1906.
General Manager, United Electric Light & Water Company, Waterbury, Connecticut.

CAMPBELL, S. K., October, 1906. (P)
Editor, *American Gas Light Journal,* 42 Pine Street, New York, New York.

CARBONELL, CORNELIUS M., September, 1913. (P)
Assistant Secretary, Astoria Light, Heat & Power Company, 130 East 15th Street, New York, New York.

CARNES, FRANK S., September, 1908.
Superintendent South Division Street Department, Peoples Gas Light & Coke Company, 38 West 64th Street, Chicago, Illinois.

CARPENTER, HAROLD, September, 1907. (P)
Resident Engineer, Astoria Tunnel, The Astoria Light, Heat & Power Company, 977 Whitlock Avenue, New York, New York.

CARROLL, LAFAYETTE D., September, 1908.
Mechanical Engineer, 38 Victoria Street, London, S. W., England.

CARSON, GEORGE S., October, 1906.
President, Iowa Gas & Electric Company, Washington, Iowa.

CARTER, ROBERT A., September, 1907. (P)
Vice-President, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

CARTER, ROBERT A., JR., September, 1908. (P)
Assistant to Engineer of Manufacture, Consolidated Gas Company, 130 East 15th Street, New York, New York.

CASTOR, WILLIAM A., October, 1906. (P)
Superintendent of Meters, United Gas Improvement Company, 30 East Tulpehocken Street, Philadelphia, Pennsylvania.

CATHELS, EDMUND, October, 1906. (P)
Engineer, 28 Plain Street, Providence, Rhode Island.

CAUSEBROOK, W. R., September, 1907.
Agent, Gas and Electric Departments, Public Service Gas Company, 210 Park Avenue, Plainfield, New Jersey.

CHADWELL, WILLIAM H., September, 1907.
Superintendent, Market Street Gas Works, Public Service Gas Company, Newark, New Jersey.

CHAMBERLAIN, GLENN R., October, 1906.
Secretary and Manager, Commercial Department, Grand Rapids Gas Light Company, Pearl and Ottawa Streets, Grand Rapids, Michigan.

CHANNON, HARRY O., March, 1911.
Manager, Quincy Gas, Electric & Heat Company, 422 Main Street, Quincy, Illinois.

CHAPIN, C. H. B., September, 1913. (P)
Secretary, Empire State Gas & Electric Association; Secretary, Joint Committee on Calorimetry for New York State, 29 West 39th Street, New York, New York.

CHAPMAN, HARLEN MONROE, September, 1913.
Superintendent, Semet-Solvay Company, Indianapolis, Indiana.

CHENEY, HERBERT NEAL, March, 1911.
Engineer of Construction, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

CHENEY, SEYMOUR WYATT, March, 1914. (N)
Assistant Engineer, American Public Utilities Company, Michigan Trust Building, Grand Rapids, Michigan.

CHEWNING, WALTER L., September, 1907. (P)
Engineering Department, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

CHICHESTER, ALFRED A., October, 1906.
Superintendent, North Division Street Department, Peoples Gas Light & Coke Company, 634 Hobbie Street, Chicago, Illinois.

CHUBB, CHESTER N., October, 1906.
Vice-President and Manager, Northern Indiana Gas & Electric Company, 519 Franklin Street, Michigan City, Indiana.

CHUBBUCK, H. E., October, 1906.
Vice-President Executive, Illinois Traction System, Peoria, Illinois.

CLABAUGH, G. W., October, 1906.
Vice-President and Secretary, Omaha Gas Company, 1509 Howard Street, Omaha, Nebraska.

CLARK, HORACE HERBERT, March, 1910.
Engineer of Gas Distribution, Public Service Company of Northern Illinois, 72 West Adams Street, Chicago, Illinois.

CLARK, JOHN A., JR., October, 1906. (P)
Engineer of Distribution, Public Service Gas Company, 35 Front Street, Newark, New Jersey.

Clark, John C. D., October, 1906.
Manager, Utah Gas & Coke Company, Salt Lake City, Utah.

Clark, Robert Browning, March, 1911.
Superintendent of Works, Fall River Gas Works Company, 512 High Street, Fall River, Massachusetts.

Clark, Walton, October, 1906. (P)
Second Vice-President, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Clark, William J., October, 1906. (P)
Vice-President, Westchester Lighting Company, 1st Avenue and 1st Street, Mount Vernon, New York.

Clark, W. Van Alan, March, 1912. (P)
With Brooklyn Union Gas Company, Foot North 12th Street, Brooklyn, New York.

Clarke, Alfred, March, 1908.
President, Various Gas Companies, 131 State Street, Boston, Massachusetts.

Clary, Edward D., October, 1906.
Superintendent, Burlington Gas Light Company, 3d and Washington Streets, Burlington, Iowa.

Clausen, William F., October, 1906.
General Manager, Winona Gas Light & Coke Company, Winona, Minnesota.

Cline, W. B., October, 1906.
President and General Manager, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Coate, P. S., October, 1906.
Manager and Secretary-Treasurer, Chatham Gas Company, Limited, King Street, West, Chatham, Ontario, Canada.

Cobb, B. C., October, 1906.
Vice-President, Bay City (Michigan) Gas Company, Hodenpyl, Hardy & Co., 14 Wall Street, New York, New York.

Cobb, S. P., October, 1906.
Raleigh, North Carolina.

Cocke, J. Bowdoin, March, 1914. (N)
Gas Engineer, Superintendent Gas Department, Rocky Mount Public Works, Rocky Mount, North Carolina.

Cohn, Chas. M., September, 1907. (P)
Vice-President, Consolidated Gas, Electric Light & Power Company, 100 West Lexington Street, Baltimore, Maryland.

Cole, C. M., October, 1906.
Superintendent, Harrisburg Gas Company, Harrisburg, Pennsylvania.

Cole, George M., October, 1906. (P)
Vice-President and Manager, Plattsburgh Gas & Electric Company, 30 Margaret Street, Plattsburgh, New York.

Cole, William W., October, 1906.
Consulting Engineer, 43 Exchange Place, New York, New York.

Coleman, Walter Ceely, March, 1914. (N)
Secretary and Treasurer, Troy Gas Company, Troy, New York.

Collin, H. M., September, 1912.
General Manager, Glenns Falls Gas & Electric Light Company, 11 Warren Street, Glenns Falls, New York.

Collins, Carroll, October, 1906. (P)
President, Treasurer and Manager, Marshall Gas Light Company, East State Street, Marshall, Michigan.

Collins, David J., October, 1906. (P)
Sales Agent, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Collins, Henry P., October, 1906.
Manager, Herkimer County Light & Power Company, 587 Albany Street, Little Falls, New York.

Collins, J. Clarence, September, 1909.
Secretary and Auditor, Rochester Railway & Light Company, 34 Clinton Avenue North, Rochester, New York.

Colquhoun, Edward M., September, 1908.
Travelling New Business Agent, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Colvin, J. E., October, 1906.
Superintendent, Muncie Gas Light & Fuel Company, 301 East Main Street, Muncie, Indiana.

Combs, Roger B., October, 1906. (P)
General Manager, Nashville Gas & Heating Company, 611 Church Street, Nashville, Tennessee.

Comstock, C. A., March, 1911.
Watertown, Wisconsin.

Congdon, Richard C., October, 1906. (P)
Secretary and General Manager, Atlanta Gas Light Company, Electric & Gas Building, Atlanta, Georgia.

Conlee, George D., September, 1913. (P)
Superintendent, Chuctanunda Gas Light Company, 33 Market Street, Amsterdam, New York.

CONNERS, MATHIAS, October, 1906.
Superintendent, Peoples Gas Light & Coke Company, 31st Street and Pitney Court, Chicago, Illinois.

CONOVER, ERNEST R., September, 1913. (P)
Superintendent, Westchester Lighting Company, 7 West Main Street, Tarrytown, New York.

COOK, CHAS. G., September, 1907.
Agent, Gas and Electric Departments, Public Service Gas Company, 222 East State Street, Trenton, New Jersey.

COOK, HENRY R., JR., September, 1907. (P)
Assistant to General Superintendent, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

COOKE, ALFRED S., October, 1906.
Manager, Citizens Gas & Electric Company, Terre Haute, Indiana.

COOPER, WM. H., October, 1906. (P)
Vice-President, Chuctanunda Gas Light Company, 96 Church Street, Amsterdam, New York.

COPLEY, HON. IRA C., October, 1906.
President, Western United Gas & Electric Company, Aurora, Illinois.

CORNINE, MARSHALL, March, 1911.
Superintendent, Repair Shops, Consolidated Gas Company, 111th Street, and 1st Avenue, New York, New York.

CORNISH, R. C., October, 1906. (P)
Engineer, American Gas Company, West Washington Square, Philadelphia, Pennsylvania.

CORSCOT, JOHN, October, 1906.
Vice-President, Madison Gas & Electric Company, 126 East Main Street, Madison, Wisconsin.

CORTELYOU, GEORGE B., March, 1912.
President, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

COVERT, IRA C., September, 1907.
Manager, Billings Gas Company, Billings, Montana.

COWDERY, EDWARD G., October, 1906. (P)
Vice-President, Peoples Gas Light & Coke Company, Peoples Gas Building, Chicago, Illinois.

COWPERTHWAIT, B. W., October, 1906.
Manager, Consumers Power Company, Central Avenue, Faribault, Minnesota.

COWPERTHWAIT, GEORGE E., September, 1912.
Secretary, Danbury & Bethel Gas & Electric Light Company, 238 Main Street, Danbury, Connecticut.

CRAFTS, HARRY C., October, 1906. (P)
Manager, Pittsfield Coal Gas Company, 30 South Street, Pittsfield, Massachusetts.

CRAHAN, B. J., October, 1906.
Superintendent, Joplin Gas Company, 318 Joplin Street, Joplin, Missouri.

CRANE, WILLIAM M., October, 1906. (P)
President, Wm. M. Crane Company, 20 West 32d Street, New York, New York.

CRAWFORD, H. T., October, 1906.
Cashier, Waukegan Gas Company, Waukegan, Illinois.

CRAWFORD, THOMAS, March, 1907. (P)
General Manager, Clinton Gas Light & Coke Company, Clinton, Iowa.

CREIGHTON, JOHN THOMAS, March, 1913.
Superintendent Gas Manufacture, Los Angeles Gas & Electric Corporation, 553 Ramirez Street, Los Angeles, California.

CRESSEY, FRANK A., JR., September, 1912.
Manager, Modesto Gas Light, Coal & Coke Company, Modesto, California.

CRESSLER, A. D., October, 1906.
President, The Kerr Murray Company, Peoples Gas Building, Chicago, Illinois.

CRESSON, B. F., October, 1906. (P)
President, Easton Gas & Electric Company, 2d and Ferry Streets, Easton, Pennsylvania.

CRIGHTON, D. K., October, 1906.
Engineer, Gas Machinery Company, 1900 Euclid Avenue, Cleveland, Ohio.

CRILLY, ROGER, October, 1906.
General Foreman, Elizabethtown Gas Light Company, 19 Loomis Street, Elizabeth, New Jersey.

CRISFIELD, J. A. P., October, 1906.
Engineer, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

CROSS, CHARLES ALFRED, March, 1911. (P)
Engineer, Williamsburgh Works, Brooklyn Union Gas Company, foot of North 12th Street, Brooklyn, New York.

Cross, Frank L., March, 1909.
General Manager, Madison Gas & Electric Company, 1020 Sherman Avenue, Madison, Wisconsin.

Cross, Philip, October, 1906. (P)
Superintendent, New Business Department, Fuel Appliances, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Croston, William F., March, 1914. (N)
Superintendent, Gas Department, Newport News & Hampton Railway, Gas & Electric Company, Newport News, Virginia.

Crowell, F. B., October, 1906.
Consulting and Contracting Engineer, Post Office Box 1006, St. Petersburg, Florida.

Crowley, John P., October, 1906.
Secretary and Treasurer, St. Paul Gas Light Company, St. Paul, Minnesota.

Crutcher, William H., September, 1911.
Superintendent, Gas Department, Louisville Gas & Electric Company, 201 Starks Building, Louisville, Kentucky.

Curran, G. W., October, 1906. (P)
Secretary, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Curtis, George W., September, 1907.
Superintendent, Camden Coke Works, Gas Department, Camden, New Jersey.

Curtis, Samuel P., October, 1906. (P)
General Manager, American Gas Company, West Washington Square, Philadelphia, Pennsylvania.

Cushman, Charles P., March, 1909.
First Vice-President, Osaka Gas Company, Limited, Osaka, Japan.

Cushman, George Herbert, September, 1908.
Superintendent, Electric Department, San Antonio Gas & Electric Company, 504 Goliad Street, San Antonio, Texas.

Cutcheon, Fredk. Richard M., March, 1913. (P)
General Manager, Consolidated Gas Company of New Jersey, 176 Broadway, Long Branch, New Jersey.

Cutcheon, Max H., March, 1913.
Industrial Gas Engineer, Detroit, Michigan.

Daily, James Madison, March, 1913.
General Manager, Pueblo Gas & Fuel Company, 514 North Main Street, Pueblo, Colorado.

Dallas, Robert E., September, 1908.
Assistant Commercial Agent, The United Gas Improvement Company, 1035 Market Street, Philadelphia, Pennsylvania.

Daly, Augustin J., October, 1906.
Superintendent City District, Laclede Gas Light Company, 2655 Adams Street, St. Louis, Missouri.

Danforth, Byron Hamilton, March, 1913.
General Manager, Indiana Fuel & Light Company, Cedar and 9th Streets, Auburn, Indiana.

Dashiell, P. T., October, 1906.
Assistant Engineer of Works, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Daugherty, George, October, 1906.
General Manager, Trumbull Public Service Company, 409 Adams Street, Warren, Ohio.

Davidson, Edward S., October, 1906.
District Manager, Illinois Northern Utilities Company, DeKalb, Illinois.

Davies, Edward Livingston, September, 1912. (P)
Gas Superintendent, Queens Boro Gas & Electric Company, 347 Central Avenue, Far Rockaway, L. I., New York.

Davies, H. W., October, 1906. (P)
Representative, Safety Car Heating & Lighting Company, 501 Commercial Trust Building, Philadelphia, Pennsylvania.

Davies, James E., September, 1908.
Division Superintendent and Manager, Calumet Division, Peoples Gas Light & Coke Company, 9051 Commercial Avenue, Chicago, Illinois.

Davis, Albert G., March, 1911.
Chemist, Consolidated Gas Company, 435 6th Avenue, Pittsburgh, Pennsylvania.

Davis, Ernest H., October, 1906.
Treasurer, Northern Central Gas Company, Lewistown, Pennsylvania, West and Willow Streets, Williamsport, Pennsylvania.

Davis, George H., September, 1912.
Member of firm Ford, Bacon & Davis, Engineers, 921 Canal Street, New Orleans, Louisiana.

Davis, R. N., March, 1907.
Assistant Superintendent, care Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

DAWES, HENRY M., March, 1914. (N)
President, Southwestern Gas & Electric Company, 111 West Monroe Street, Chicago, Illinois.

DAWES, RUFUS C., October, 1906. (P)
President, Mobile (Alabama) Gas Company, 111 West Monroe Street, Chicago, Illinois.

DAY, ADDISON BLANCHARD, March, 1913
Manager of Operation, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

DAY, C. L., October, 1906.
General Superintendent, Street and Meter Department, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

DE CASTRO, JOSEPH L., September, 1911. (P)
Assistant Superintendent, Consolidated Gas Company, foot of East 115th Street, New York, New York.

DEFREITAS, WILLIAM, March, 1910. (P)
Assistant Superintendent, Appliance Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

DE FRESE, S. E., March, 1914. (N)
General Manager, Chattanooga Gas Company, 926 Market Street, Chattanooga, Tennessee.

DELL, JOHN, October, 1906. (P)
President, Missouri Fire Brick Company, 411 Olive Street, St. Louis, Missouri.

DELONG, JAMES C., September, 1908. (P)
President, Syracuse Lighting Company, 335 South Warren Street, Syracuse, New York.

DEQUINE, LOUIS EDWARD, September, 1914. (N) (P)
General Superintendent, Consolidated Gas Company of New Jersey, 64 South Fifth Avenue, Long Branch, New Jersey.

DE VOE, FREDERICK R., March, 1913.
Secretary and Treasurer, Northern Union Gas Company, 1815 Webster Avenue, Bronx, New York, New York.

DEWEY, V. F., October, 1906. (P)
General Manager, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

DEXTER, MACDOUGALD, October, 1906.
Superintendent, Gas Light Company of Columbus, 1151 Broad Street, Columbus, Georgia.

Dickey, Charles H., October, 1906. (P)
Charles H. Dickey & Company, Baltimore, Maryland.

Dickey, E. D. V., March, 1909.
Manager, Freeport Gas Company, 156 Stephenson Street, Freeport, Illinois.

Dickey, Samuel J., March, 1908, (P)
Engineer, Gas Department, Syracuse Lighting Company, 335 South Warren Street, Syracuse, New York.

Dieterle, Edward A., March, 1908.
Chemist, Seattle Lighting Company, Seattle, Washington.

Dillon, Harry J., September, 1911.
Superintendent, Brooklyn Borough Gas Company, Coney Island, New York.

Dixon, J. Alfred, October, 1906.
Vice-President and Manager, Pintsch Compressing Company, 2 Rector Street, New York, New York.

Dixon, R. M., October, 1906.
Vice-President, Pintsch Compressing Company, 2 Rector Street, New York, New York.

Doane, George W., September, 1910.
President, New Amsterdam Gas Company, 22 East 22d Street, New York, New York.

Doherty, Henry L., October, 1906.
Chairman of Board, Denver Gas & Electric Light Company, 60 Wall Street, New York, New York.

Dole, Walter S., October, 1906.
Chief Engineer, Santa Monica Water Company, 1440 Second Street, Santa Monica, California.

Dolley, George M., October, 1906.
Manager, Indiana Lighting Company, Logansport, Indiana.

Donahue, E. J., October, 1906. (P)
Engineer, Hudson Division, Public Service Gas Company, St. Paul and St. James Avenues, Jersey City, New Jersey.

Dorner, William F., October, 1906.
Superintendent, 25th Ward Gas Works, United Gas Improvement Company, Richmond and Tioga Streets, Philadelphia, Pennsylvania.

Dorr, William J., September, 1907.
Superintendent of Gas Distribution, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Doty, Paul, October, 1906. (P)
Vice-President and General Manager, St. Paul Gas Light Company, 159 East Sixth Street, St. Paul, Minnesota.

Dougherty, Benjamin R., October, 1906.
Superintendent, Richmond Water & Light Company, Richmond, Kentucky.

Douglas, Henry W., October, 1906.
Manager, Ann Arbor Gas Company, 211 East Huron Street, Ann Arbor, Michigan.

Douglas, James B., September, 1909. (P)
Manager, Claim Department, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Douthirt, W. F., October, 1906.
Fourth Vice-President, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Dow, Fred N., March, 1914. (N)
President, Portland Gas Light Company, Box 668, Portland, Maine.

Down, Frederick J., March, 1910. (P)
Superintendent, 42d Street Station, Consolidated Gas Company, Foot West 42d Street, New York, New York.

Downey, James N., September, 1907.
Assistant Superintendent, Camden Coke Company, Camden, New Jersey.

Drake, Francis Edward, September, 1914. (N)
Manager, Gas Department, Lynn Gas & Electric Company, 90 Exchange Street, Lynn, Massachusetts.

Dudley, A. D., March, 1908.
New Business Agent, Syracuse Lighting Company, Syracuse, New York.

Duggan, Frank P., March, 1911.
Superintendent, Gas Department, Penn Central Light & Power Company, 31 West Market Street, Lewistown, Pennsylvania.

Dunbar, James W., October, 1906.
Superintendent, United Gas & Electric Company, 138 E. Spring Street, New Albany, Indiana.

Duncan, Ronald Bruce, September, 1911. (P)
Superintendent, Spring Garden District, United Gas Improvement Company, 1615 North 9th Street, Philadelphia, Pennsylvania.

Dunn, F. S., October, 1906. (P)
Engineer, Municipal Gas Company, 1131 Broadway, Albany, New York.

Dunne, Philip, October, 1906. (P)
Night Superintendent, Consolidated Gas Company of New York, 558 West 170th Street, New York, New York.

Durkee, Charles C., September, 1909.
Superintendent, Pueblo Gas & Fuel Company, 811 West 18th Street, Pueblo, Colorado.

Dustin, Guy K., October, 1906.
48 Macon Street, Brooklyn, N. Y.

Dutter, H. O., October, 1906.
Manager, Bucyrus Telephone Company, Bucyrus, Ohio.

Dutton, Lewis R., October, 1906. (P)
Division Manager, Jenkintown District, Philadelphia Suburban Gas & Electric Company, Wyncote, Pennsylvania.

Dutton, R. H., October, 1906.
Colmar, Pennsylvania.

Earnshaw, Edward H., October, 1906. (P)
Assistant General Manager, Public Service Gas Company, 759 Broad Street, Newark, New Jersey.

Eastman, Joseph Peter, September, 1914. (N)
Secretary and Superintendent, Manitowoc Gas Company, Manitowoc, Wisconsin.

Eaton, Alfred B., October, 1906.
Vice-President, Sheboygan Gas Light Company, 1519 Peoples Gas Building, Chicago, Illinois.

Eaton, Cyrus S., September, 1914. (N)
President and Manager, Continental Gas & Electric Corporation, Cuyahoga Building, Cleveland, Ohio.

Eaton, Homer M., March, 1910.
General Manager, Columbus Gas Light Company, 404 Washington Street, Columbus, Indiana.

Eaton, James B., March, 1907.
Purchasing Agent, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

Eaton, W. M., October, 1906.
Director, Michigan Light Company; Hodenpyl, Hardy & Company, 1834 Fourth Street, Jackson, Michigan.

EAVENSON, WILLIAM K., October, 1906. (P)
Special Representative, Industrial Gas Appliance Laboratory, Consolidated Gas Company, 130 East 15th Street, New York, New York.

EGNER, FREDERIC, October, 1906.
Consulting Engineer, City Gas Works of Fredericksburg, Virginia, Retired Gas and Mechanical Engineer, 516 Quincy Street, N. W., Washington, District of Columbia.

EILBECK, A. B., October, 1906.
New York, New York.

EINSTEIN, A. C., March, 1908.
Vice-President and General Manager, St. Louis County Gas Company, 315 North 12th Street, St. Louis, Missouri.

ELBERT, V. L., October, 1906.
General Manager, St. Joseph Gas Company, 8th and Francis Streets, St. Joseph, Missouri.

ELDER, DAVID, September, 1907.
United States Steel Corporation Coke Ovens, 733 Jefferson Street, Gary, Indiana.

ELLIOTT, ARTHUR H., October, 1906. (P)
Consulting Engineer-Chemist, 30 Church Street, New York, New York.

ELLIOTT, LARUE B., September, 1908.
Division Superintendent, North Division Street Department, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

ELLIS, HARRY, September, 1907.
Superintendent of Distribution, Public Service Gas Company, Front and Cherry Streets, Camden, New Jersey.

ELLIS, JOHN W., October, 1906. (P)
President and Manager, Providence Gas Company, 20 Market Square, Providence, Rhode Island.

ELSTON, I. C., JR., October, 1906.
Elston, Clifford & Company, 707 New York Life Building, 39 South LaSalle Street, Chicago, Illinois.

ELY, FRANKLIN J., March, 1908.
Purchasing Agent, Peoples Gas Light & Coke Company, Peoples Gas Building, Chicago, Illinois.

ELY, SETH HARRISON, March, 1908. (P)
Manager, Dover, Rockaway & Port Oram Gas Company, 49 North Sussex Street, Dover, New Jersey.

ENGEL, FRANCIS, October, 1906. (P)
Superintendent, Elizabethtown Gas Light Company, Elizabeth, New Jersey.

ENGLISH, A. L., October, 1906.
Manager, Citizens Gas & Electric Company, 26 Pearl Street, Council Bluffs, Iowa.

ENRIGHT, J. H., October, 1906.
Manager, Frederick Gas & Electric Company, Frederick, Maryland.

ESTBERG, HOWARD C., September, 1911.
Engineer, Utah Gas & Coke Company, Salt Lake City, Utah.

EUSTACE, JOHN H., October, 1906. (P)
Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

EVANS, CHARLES D., March, 1911.
Division Superintendent, Philadelphia Company, 435 6th Avenue, Pittsburgh, Pennsylvania.

EVANS, GEORGE B., October, 1906.
Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

EVANS, OWEN BROOKE, September, 1907. (P)
Superintendent, Experimental Plant, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

EVES, PHILMER, September, 1907. (P)
Advertising Manager, New Haven Gas Light Company, 80 Crown Street, New Haven, Conn.

EWING, ALONZO PRENTISS, March, 1913. (P)
Assistant General Manager, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

EYMAN, CHARLES M., March, 1912.
Manager, Boise Gas Light & Coke Company, Boise, Idaho.

EYSENBACH, E. E., October, 1906.
General Manager, San Antonio Gas & Electric Company, San Antonio, Texas.

FAIR, CAMPBELL W., October, 1906.
President and Manager, Webster City Gas Company, Webster City, Iowa.

FANCHER, NATHANIEL C., March, 1910.
Superintendent of Manufacture, Seattle Lighting Company, Seattle, Washington.

FARR, ALBERT L., October, 1906.
Engineering Department, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

FENNIMAN, JOHN ROFF, March, 1914. (N) (P)
Superintendent, Consolidated Gas Company, 1907 Amsterdam Avenue, New York, New York.

FERGUSON, B. B., October, 1906. (P)
President and Superintendent, Portsmouth Gas Company, 512 High Street, Portsmouth, Virginia.

FERRIER, JAMES, October, 1906.
President, Rome Municipal Gas Company, 420 Broad Street, Rome, Georgia.

FERRIS, HERBERT H., October, 1906. (P)
Engineer of Manufacture, Essex Division, Public Service Gas Company, 446 Market Street, Newark, New Jersey.

FIELD, ROY ALBRIGHT, October, 1906.
Vice-President and General Manager, Kentucky Public Service Company, Inc., Hopkinsville, Kentucky.

FIRSTBROOK, HARRY, March, 1914. (N)
Manager, Bessemer Gas Company, Bessemer, Alabama.

FISHER, DAVID G., October, 1906.
202 Bechtel Building, Davenport, Iowa.

FISHER, HOWELL, March, 1911. (P)
Assistant Superintendent, New England Gas & Coke Company, Everett, Massachusetts.

FITZ, ROBERT F., October, 1906.
Consulting Engineer, Post Office Box 275, Los Angeles, California.

FITZGERALD, LEONARD, October, 1906.
Superintendent, Gas & Electric Department, Gary Heat, Light & Water Company, Broad and Fifth Avenue, Gary, Indiana.

FLOOK, WILLIAM M., March, 1908.
Assistant Secretary, Peoples Gas Light & Coke Company of Chicago, Illinois, 54 Wall Street, New York, New York.

FLOWERS, DEAN WILCOX, September, 1907. (P)
General Superintendent, St. Paul Gas Light Company, 6th and Jackson Streets, St. Paul, Minnesota.

FLOYD, JAMES R., October, 1906.
Assistant Treasurer, International Agricultural Corporation, 165 Broadway, New York, New York.

FOGG, OSCAR H., October, 1906. (P)
Engineer of Utilization, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Folger, Oliver H., September, 1912. (P)
Assistant Superintendent of Distribution, Public Service Gas Company, 40 Columbia Avenue, Passaic, New Jersey.

Folsom, Robert Morse, September, 1911.
Second Assistant Superintendent, New England Gas & Coke Company, Everett, Massachusetts.

Ford, A. H., October, 1906.
President, Birmingham Railway, Light & Power Company, Birmingham, Alabama.

Forstall, Alfred E., October, 1906.
Consulting Engineer, Secretary Trustees Gas Educational Fund, 84 William Street, New York, New York.

Forstall, Walton, October, 1906. (P)
Assistant Engineer of Distribution, Philadelphia Gas Works, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Foshay, W. B., September, 911.
Manager, Northwestern Electric Co., Portland, Oregon.

Fowler, Samuel J., October, 1906.
Treasurer and Agent, Charlestown Gas & Electric Company, 29 Main Street, Charlestown, Massachusetts.

Fox, Clifford S., October, 1906. (P)
Superintendent, East River Gas Company, Webster Avenue and East River, Long Island City, New York.

Francis, J. Edward, September, 1912.
Superintendent, Suffolk Gas-Electric Company, Suffolk, Virginia.

Francklyn, Charles G., March, 1911. (P)
General Agent, Central Union Gas Company, 519 Courtlandt Avenue, New York, New York.

Francklyn, Gilbert, March, 1909. (P)
Engineer of Distribution, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Frazer, D. H., October, 1906. (P)
Vice-President and General Manager, Calhoun Gas Company, 26 East Main Street, Battle Creek, Michigan.

Freeman, Frederick Charles, September, 1910. (P)
Engineer, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Freese, Fred. W., October, 1906.
General Manager, Utah Valley Gas & Power Company, Provo, Utah.

FRICK, JOHN A., October, 1906. (P)
Vice-President and General Manager, Allentown-Bethlehem Gas Company, 516 Hamilton Street, Allentown, Pennsylvania.

FRUEAUFF, FRANK W., October, 1906. (P)
President, Denver Gas & Electric Light Company, H. L. Doherty & Company, 60 Wall Street, New York, New York.

FRUEAUFF, HARRY D., March, 1910.
Treasurer and General Manager, City Light & Traction Company, 404 South Ohio Street, Sedalia, Missouri.

FULWEILER, JOHN EDWIN, September, 1914. (N)
Engineer, American Gas Utilities Company, 1123 Healey Building, Atlanta, Georgia.

FULWEILER, WALTER HERBERT, September, 1907. (P)
Chemist, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

FURLONG, WILLIAM G., March, 1911. (P)
Secretary and Treasurer, Municipal Gas Company, 112 State Street, Albany, New York.

GADSDEN, P. H., March, 1911.
President, Charleston Consolidated Railway & Lighting Company, Charleston, South Carolina.

GALLOWAY, EDWARD WILLIAM, March, 1913.
Assistant Engineer, Gas Department, Illinois Northern Utilities Company, Dixon, Illinois.

GALT, JAMES HENRY, September, 1913.
Superintendent of Works and Distribution, Public Service Gas Company, 147 East Hanover Street, Trenton, New Jersey.

GANNON, JOHN J., October, 1906.
Superintendent and Agent, Vicksburg Gas Company, Post Office Box 258, Vicksburg, Mississippi.

GANSER, HERBERT H., October, 1906.
Manager, Counties Gas & Electric Company, 212 DeKalb Street, Norristown, Pennsylvania.

GANZ, ALBERT FREDERICK, September, 1913.
Consulting Engineer; Professor of Electrical Engineering, Stevens Institute of Technology, Hoboken, New Jersey.

GARRISON, RALPH HOWARD, March, 1914. (N) (P)
General Superintendent, Standard Gas Company, Atlantic Highlands, New Jersey.

GARTLAND, C. C., October, 1906.
4082 East 76th Street, Cleveland, Ohio.

GARTLEY, WILLIAM H., October, 1906. (P)
Engineer of Philadelphia Gas Works, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

GAVIT, E. P., October, 1906.
Albany, New York.

GAWTRY, LEWIS B., September, 1908. (P)
Vice-President, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

GEFVERT, CHARLES J., September, 1910. (P)
Engineer's Assistant, Consolidated Gas Company, 130 East 15th Street, New York, New York.

GEIST, CARLTON, March, 1912.
General Manager, Atlantic City Gas Co., 2001 Atlantic Avenue, Atlantic City, New Jersey.

GEIST, CLARENCE H., March, 1912.
President, Atlantic City Gas Company, 1127 Land Title Building, Philadelphia, Pennsylvania.

GENAY, THOMAS BERTRAM, October, 1906.
Superintendent of Manufacturing, Des Moines Gas Company, 412 West 7th Street, Des Moines, Iowa.

GENAY, THOMAS S., October, 1906.
Chief Clerk to Second Vice-President, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

GERDENIER, C. M., March, 1909. (P)
Superintendent, Bridgeport Gas Light Company, 174 Arch Street, Bridgeport, Connecticut.

GEROULD, CHARLES L., October, 1906.
Thompson, Connecticut.

GIFFORD, N. W., October, 1906. (P)
General Manager, East Boston Gas Company, 26 Central Square, East Boston, Massachusetts.

GILCHRIST, JOHN FOSTER, September, 1914. (N)
President, Missouri Gas & Electric Service Company, 120 West Adams Street, Chicago, Illinois.

GILL, JOHN E., September, 1914. (N)
President, The Manufacturers Light & Heat Company, 248 Fourth Avenue, Pittsburgh, Pennsylvania.

GILLETT, MELVILLE, October, 1906.
Director, Gas Companies, Newark, Ohio.

GILLINGHAM, HUBERT D., October, 1906. (P)
Assistant Sales Manager, Public Service Gas Company, 759 Broad Street, Newark, New Jersey.

GILPIN, FRANCIS HOPKINSON, September, 1907. (P)
Gas Engineer, United Gas Improvement Company, 3101 Passyunk Avenue, Philadelphia, Pennsylvania.

GINLEY, JOHN, September, 1908.
Superintendent, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

GLASGOW, ARTHUR GRAHAM, October, 1906. (P)
Humphreys & Glasgow, 36 Victoria Street, London, S. W., England.

GLASS, SHELDON J., October, 1906.
Vice-President, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

GOLDEN, JOHN W., October, 1906.
Vice-President, Savannah Gas Company, 9 Congress Street, West, Savannah, Georgia.

GOODNOW, GEORGE F., October, 1906.
General Manager, North Shore Gas Company, 213 North Genesee Street, Waukegan, Illinois.

GORDON, LEROY O., March, 1913.
Manager, Valparaiso Lighting Company, 152 West Main Street, Valparaiso, Indiana.

GOUDY, ROY ALONZO, March, 1914. (N)
Manager, Petersburg Gas Company, 230 South Sycamore Street, Petersburg, Virginia.

GOUDY, W. R., October, 1906.
With Williamson & Mead, 30 East 42d Street, New York, New York.

GOULD, JOHN A., October, 1906. (P)
Engineer of Distribution, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

GRAEFF, HAROLD W., October, 1906.
1513 North Thirty-third Street, Philadelphia, Pennsylvania.

GRAF, CARL H., October, 1906. (P)
Vice-President and General Manager, Municipal Gas Company, 112 State Street, Albany, New York.

GRAHAM, ALLAN S., September, 1908. (P)
Superintendent, Gas Department, Northern Indiana Gas & Electric Company, 571 Hohman Street, Hammond, Indiana.

GRAHAM, MALCOLM M., October, 1906.
Secretary and Treasurer, New Amsterdam Gas Company, 130 East 15th Street, New York, New York.

GRANT, ROBERT, September, 1907.
Treasurer, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

GRAVELEY, RICHARD C., September, 1914. (N)
District Manager, Western United Gas & Electric Company, 30 Burlington Avenue, LaGrange, Illinois.

GREACEN, W., JR., September, 1907.
Agent, Public Service Gas Company, 591 Spring Street, West Hoboken, New Jersey.

GREY, JOHN CHESTER, September, 1908.
Superintendent, Savannah Gas Company, 9 Congress Street, West, Savannah, Georgia.

GRIBBEL, JOHN, October, 1906. (P)
President, Tampa (Florida) Gas Company, 1513 Race Street, Philadelphia, Pennsylvania.

GRISWOLD, R. G., October, 1906. (P)
Gas Engineer, with H. L. Doherty & Company, 60 Wall Street, New York, New York.

GRUBER, CHARLES A., September, 1912.
Manager, Saranac Lake Gas Company, 20 Main Street, Saranac Lake, New York.

GUFFEY, JOSEPH F., October, 1906.
General Manager, The Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

GUNN, ARTHUR, March, 1914. (N)
President, Wenatchee Valley Gas & Electric Company, Wenatchee, Washington.

GULDLIN, OLAF N., October, 1906. (P)
President, Western Gas Construction Company, 2306 Fairfield Avenue, Fort Wayne, Indiana.

HAAG, F. E., March, 1909.
Auditor, Williamsport (Pa.) Gas Company, H. D. Walbridge & Company, 14 Wall Street, New York, New York.

HAASE, EWALD, October, 1906.
Secretary and Treasurer, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

HACKSTAFF, JOHN DUDLEY, September, 1913.
Consulting Engineer, General Manager, Southern California Gas Company, Garland Building, Los Angeles, California.

HADDOCK, ISAAC T., September, 1913.
Chemist for Cambridge Gas Light Company, 354 Third Street, East Cambridge, Massachusetts.

HAFTENKAMP, JOSEPH P., September, 1907.
Assistant Superintendent, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

HAIGHT, THEODORE, March, 1911. (P)
Superintendent, Equity Works, Brooklyn Union Gas Company, Maspeth and Porter Avenues, Brooklyn, New York.

HAINES, JANSEN, October, 1906. (P)
Manager, Des Moines Gas Company, 412 West 7th Street, Des Moines, Iowa.

HALL, A. H., October, 1906. (P)
Assistant Secretary and Superintendent of Distribution, Central Union Gas Company, 519 Courtlandt Avenue, New York, New York.

HALL, ELMON LAWRENCE, September, 1912.
Chief Engineer, Portland Gas & Coke Company, 292 Yamhill Street, Portland, Oregon.

HALSEY, WILLIAM M., March, 1909. (P)
Agent, Public Service Gas Company, Gas and Electric Departments, 759 Broad Street, Newark, New Jersey.

HAMMATT, CLARENCE S., October, 1906.
Consulting Engineer, 1943 Main Street, Jacksonville, Florida.

HAMMON, WILLIAM H., October, 1906.
President, Hope Engineering & Supply Company, 902 Farmers Bank Building, Pittsburgh, Pennsylvania.

HAMMOND, WILBER M. R., March, 1912.
Comptroller, New York & Richmond Gas Company, 691 Bay Street, Stapleton, Staten Island, New York.

HANLAN, J. P., September, 1907. (P)
Agent, New Business Department, Public Service Gas Company, Post Office Box 590, Newark, New Jersey.

HANTZMON, H. M., October, 1906.
Superintendent, City Gas Department, Charlotteville, Virginia.

HARDICK, CHARLES F., October, 1906.
District Superintendent and Agent, United Gas Improvement Company, 5961 Ridge Avenue, Philadelphia, Pennsylvania.

HARE, C. WILLING, September, 1908.
Manager, New Business Department, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

HARE, JOSEPH B., March, 1913. (P)
Assistant Superintendent, Mains and Services, Central Union Gas Company, 519 Courtlandt Avenue, New York, New York.

HARGREAVES, ROBERT H., September, 1912.
Superintendent, Gas Works, Pacific Gas & Electric Company, 48 East San Antonio Street, San Jose, California.

HARLOW, JUSTIN EDWARDS, March, 1913.
Construction Engineer, Illinois Northern Utilities Company, 806 3rd Street, Dixon, Illinois.

HARPER, ROBERT BRINTON, March, 1908.
Superintendent of Testing Laboratories, Peoples Gas Light and Coke Company, 2501 Salt Street, Chicago, Illinois.

HARRIES, GEORGE HERBERT, September, 1912.
President, Louisville Gas & Electric Company, 311 West Chestnut Street, Louisville, Kentucky.

HARRIMAN, HORACE MARSHALL, March, 1908.
General Superintendent, New Orleans Gas Light Company, 201 Baronne Street, New Orleans, Louisiana.

HARRINGTON, WALTER K., September, 1908. (P)
Manager, The American Meter Company, 11th Avenue and 47th Street, New York, New York.

HARRISON, GEORGE MORTON, March, 1908.
Engineer, 1309 Rockland Street, Philadelphia, Pennsylvania.

HARROP, H. B., DR., October, 1906.
Manager, Société Anonymé du Gaz, Rio de Janeiro, Brazil.

HART, JULIAN G., September, 1912.
Engineer, Gas Production, Public Service Company of Northern Illinois, 72 West Adams Street, Chicago, Illinois.

HARTMAN, WILLIAM E., October, 1906. (P)
Consulting Engineer, 915 Webster Building, Chicago, Illinois.

HATHAWAY, E. C., October, 1906.
Vice-President and General Manager, City Gas Company of Norfolk, 82 Plume Street, Norfolk, Virginia.

HAUG, JOHN SOBIESKI, September, 1914. (N)
Assistant Engineer, Gas Department, Montreal Light, Heat & Power Company, 177 Harbour Street, Montreal, Canada.

HAWTHORNE, WILLIAM JAMES, September, 1908. (P)
Superintendent, Water Gas Plant, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

HAYES, CLIFTON R., September, 1912.
Manager, Fitchburg Gas & Electric Light Company, 256 Main Street, Fitchburg, Massachusetts.

HAYES, WILLIAM PARSONS, March, 1914. (N) (P)
Supervisor of Building, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

HEDGES, WILLIAM C., October, 1906. (P)
Secretary and Treasurer, Mansfield Gas Light Company, 8 South Park Street, Mansfield, Ohio.

HELLEN, FRANK, March, 1907.
Superintendent, Gas Distribution Department, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

HELLEN, JOHN, October, 1906. (P)
Superintendent of Distribution, Grand Rapids Gas Light Company, 109 North Ottawa Street, Grand Rapids, Michigan.

HELME, WILLIAM E., October, 1906. (P)
Director several Gas Companies, 1339 Cherry Street, Philadelphia, Pennsylvania.

HELPS, GEORGE, September, 1913.
Civil Engineer, Engineer and Manager, Nuneaton Gas Company, Nuneaton, England.

HEMMINGER, GEORGE REVERDEY, September, 1908.
Engineer with The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

HENDERSON, SAMUEL W., September, 1912.
Vice-President and General Manager, Water, Gas & Electric Company, Excelsior Springs, Missouri.

HENDERSON, WILLIAM M., September, 1912.
Assistant Gas Engineer, Pacific Gas & Electric Company, 445 Sutter Street, San Francisco, California.

HENDRICKSON, GEORGE S., March, 1914. (N)
Superintendent's Assistant, Brooklyn Union Gas Company, 12th Street and Gowanus Canal, Brooklyn, New York.

HENOFER, J. P., March, 1909. (P)
Superintendent, Holder Stations, Public Service Gas Company, St. Paul and St. James Avenues, Jersey City, New Jersey.

HERING, EDWARD, March, 1913.
Assistant to Chief Engineer, United States Cast Iron Pipe & Foundry Company, Burlington, New Jersey.

HEWITT, ARTHUR, September, 1910. (P)
General Manager, Consumers Gas Company, 19 Toronto Street, Toronto, Ontario, Canada.

HILLEMEYER, JOSEPH E., March, 1910.
Engineer, St. Louis County Gas Company, Lockwood and McClure Avenues, Webster Groves, Missouri.

HIMSWORTH, HINES HORACE, March, 1914. (N) (P)
Superintendent's Assistant, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

HINE, WILLARD FOSTER, September, 1911. (P)
Chief Gas Engineer, Public Service Commission for the First District, 154 Nassau Street, New York, New York.

HINMAN, CHARLES W., October, 1906. (P)
Chemical Engineer, 10 Fenwick Road, Winchester, Massachusetts.

HINTZE, THOMAS HENRY, March, 1914. (N)
Superintendent, Sassafras Point Station, Providence Gas Company, Providence, Rhode Island.

HIRAMATSU, SUYEKUCHI, October, 1906.
Chief Engineer, Tokio Gas Company, Nishikicho, Kanda, Tokio, Japan.

HIRST, HOMER T., September, 1910.
Assistant Superintendent, Street Department, Peoples Gas Light & Coke Company, 634 Hobbie Street, Chicago, Illinois.

HIRST, JESSE BOWMAN, September, 1910.
Superintendent of Pressures, Peoples Gas Light & Coke Company, Peoples Gas Building, Chicago, Illinois.

HODGES, C. H., March, 1909. (P)
Assistant Superintendent, Consolidated Gas Company of New York, 501 East 21st Street, New York, New York.

HOFFMAN, HOWARD, October, 1906. (P)
Superintendent, Gas Department, Counties Gas & Electric Company, Ardmore, Pennsylvania.

HOFMANN, G. MAX, October, 1906.
General Superintendent, Fort Wayne Gas Company, Fort Wayne, Indiana.

HOFMANN, LOTHAR, October, 1906.
Assistant Engineer, Fort Wayne Gas Company, 2205 Broadway, Fort Wayne, Indiana.

HOLDEN, THOMAS F., October, 1906.
Superintendent of Works, Georgetown Gas Light Company, 218 Eighth Street, S. W., Washington, District of Columbia.

Holman, C. L., October, 1906.
President and General Manager, The Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

Holzer, Edwin G., October, 1906. (P)
Superintendent, Easton Gas & Electric Company, 349 Bushkill Street, Easton, Pennsylvania.

Hone, Frederic deP., September, 1911.
Consulting Engineer, 1 Liberty Street, New York, New York.

Horning, George R., September, 1908.
Manager, Macon Gas Company, Macon, Georgia.

Hough, David Leavitt, October, 1906.
President, United Engineering & Contracting Company, 17 West 42d Street, New York, New York.

Houghton, Charles P., September, 1910.
Second Vice-President, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Howard, Abram C., October, 1906. (P)
Gas Engineer, United Gas & Electric Engineering Corporation, New York, New York.

Howard, Charles A., September, 1906.
President, Aberdeen Gas Company, Aberdeen, South Dakota.

Howland, Lewis A., March, 1910. (P)
General Superintendent, Queens Borough Gas & Electric Company, Far Rockaway, New York.

Hoy, Chas. W., March, 1908. (P)
Manager, New Jersey Gas Company, Glassboro, New Jersey.

Hoyt, Harry B., October, 1906.
General Manager, Jacksonville Gas Company, Church and Laura Streets, Jacksonville, Florida.

Hoyt, William G., October, 1906. (P)
President, The Standard Gas Light Company, 130 East 15th Street, New York, New York.

Huber, Frank, October, 1906. (P)
Assistant Superintendent, Gas Department, Louisville Gas & Electric Company, 7th and Ormsby Streets, Louisville, Kentucky.

Huddle, Wiley Jerome, March, 1913.
Sloan, Huddle, Feustel & Freeman, Washington Building, Madison, Wisconsin.

Hudson, Darwin S., March, 1909. (P)
Supervising Field Engineer, Construction Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

HUESTIS, LEON DAVID, March, 1909.
Superintendent of Manufacture, Philadelphia Suburban Gas & Electric Company, 912 Highland Avenue, Chester, Pennsylvania.

HULSWIT, FRANK T., October, 1906. (P)
President, United Light & Railway Company, 411 Michigan Trust Building, Grand Rapids, Michigan.

HULSWIT, JOHN A., March, 1912.
Treasurer, Grand Rapids Gas Light Company, Pearl and Ottawa Streets, Grand Rapids, Michigan.

HUMPHREYS, ALEXANDER C., October, 1906. (P)
President, Buffalo (N. Y.) Gas Company, and President, Humphreys & Miller, 165 Broadway, New York, New York.

HUMPHREYS, C. J. R., October, 1906. (P)
Vice-President and Agent, Lawrence Gas Company, 370 Essex Street, Lawrence, Massachusetts.

HUMPHREYS, FRANK WILDER, March, 1911. (P)
In charge Gas Appliance Display Rooms, Consolidated Gas Company, 30 East 42d Street, New York, New York.

HUMPHREYS, J. J., October, 1906. (P)
Gas Engineer, Tyson, Vermont.

HUMPHRYS, HENRY M., October, 1906.
Superintendent, West Side Works, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

HUNT, H. R., October, 1906.
Division Superintendent, Peoples Gas Light & Coke Company, 25th and Loomis Streets, Chicago, Illinois.

HUNTER, CHARLES WESLEY, September, 1910.
Vice-President and General Manager, Ocala Gas Company, Ocala, Florida.

HUNTER, CHAS. W., September, 1909. (P)
Gas Engineer, with Stone & Webster Engineering Corporation, 147 Milk Street, Boston, Massachusetts.

HUNTER, J. F., March, 1909.
Assistant Engineer of Construction, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

HURLBURT, A., October 1906.
Engineer, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

HUTCHINGS, JAMES T., September, 1907.
General Manager, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

HUTCHINSON, FRANK R., October, 1906.
Care of East Ohio Gas Company, 621 Superior Avenue, N. E., Cleveland, Ohio.

HYDE, EDWARD BOLTON, September, 1911.
Superintendent, Commercial Department, New Amsterdam Gas Company, 130 East 15th Street, New York, New York.

HYDE, HENRY H., October, 1906.
Secretary and Treasurer, Peoples Gas Company, 51 Sherman Street, Deadwood, South Dakota.

IKENA, FREDERICK J., September, 1912.
Superintendent of Works, Municipal Gas Company, 1131 Broadway, Albany, New York.

IVES, HERBERT E., March, 1913.
Physicist, The United Gas Improvement Company, 3101 Passyunk Avenue, Philadelphia, Pennsylvania.

JACK, WALLACE A., March, 1914. (N) (P)
Assistant Construction Engineer, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

JACKSON, DUGALD C., March, 1914. (N)
Senior Member of Firm of D. C. & Wm. B. Jackson, 248 Boylston Street, Boston, Massachusetts.

JACKSON, THOMAS H., March, 1910.
General Agent, Philadelphia Gas Works, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

JACKSON, WILLIAM B., October, 1906.
Consulting Engineer, 111 West Monroe Street, Chicago, Illinois.

JACOBSON, ERNEST, September, 1910.
Care of David G. Fisher & Company, 202 Bechtel Building, Davenport, Iowa.

JAMES, F. M., October, 1906.
General Accountant, Western United Gas & Electric Company, Aurora, Illinois.

JAMES, ROBERT C., September, 1907. (P)
General Auditor, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

JARDINE, DAVID WILLIAM, September, 1913. (P)
Assistant Manager, Burlington Light & Power Company, Burlington, Vermont.

JAYNE, RALPH A., March, 1913.
Superintendent of Distribution, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Jelliffe, C. N., October, 1906. (P)
Second Vice-President, American Light & Traction Company, 40 Wall Street, New York, New York.

Jennings, Robt. J., October, 1906. (P)
Superintendent, Pelham Works, Westchester Lighting Company, 1st Avenue and 1st Street, Mt. Vernon, New York.

Jochum, Henry Lux, March, 1914. (N) (P)
Field Engineer in Charge, Astoria Construction, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

Johnson, Adolph C., September, 1913. (P)
Assistant Superintendent, Consolidated Gas Company, 112 West 42d Street, New York, New York.

Johnson, Guy Maxwell, September, 1912.
Engineer, Nashville Gas & Heating Company, 611 Church Street, Nashville, Tennessee.

Johnson, Herbert Gilmore, October, 1906. (P)
Superintendent of Manufacture, Utica Gas & Electric Company, 222 Genesee Street, Utica, New York.

Johnson, Ole Seaholm, September, 1913.
Main Foreman, St. Paul Gas Light & Coke Company, 6th and Jackson Streets, St. Paul, Minnesota.

Johnston, Mervyn E., October, 1906. (P)
Assistant Secretary and Assistant Treasurer, Ogden Gas Company, The Linde Air Products Company, 30 East 42d Street, New York, New York.

Jones, Arthur O., September, 1912.
Engineer, 71 Himley Road, Dudley, Worcestershire, England.

Jones, Edward C., October, 1906. (P)
Chief Engineer, Gas Department, Pacific Gas & Electric Company, 702 Grant Building, 7th and Market Streets, San Francisco, California.

Jones, Edward Stratton, September, 1914. (N)
Superintendent Gas Works, Pacific Gas & Electric Company, Sacramento, California.

Jones, Edwin Dubose, March, 1913. (P)
General Foreman, Assistant to Superintendent, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Jones, Edwin Peirce, September, 1912. (P)
Superintendent, with United Gas Improvement Company, 1943 South Cecil Street, Philadelphia, Pennsylvania.

Jones, Henry Harrison, September, 1912.
Vice-President and Manager, San Diego Consolidated Gas & Electric Company, San Diego, California.

Jones, Paul R., March, 1908.
Auditor, Henry L. Doherty & Company, 60 Wall Street, New York, New York.

Jones, Thomas Clive, October, 1906.
President, Delaware Gas Company, 68 North Sandusky Street, Delaware, Ohio.

Jones, Thomas J., March, 1907.
With The Columbus Gas & Fuel Company, 135 North Front Street, Columbus, Ohio.

Jourdan, Edward R., October, 1906. (P)
General Superintendent of Mains, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Jourdan, James H., October, 1906.
Vice-President and Chief Engineer, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Kaltwasser, Charles M., March, 1913.
General Manager, Harrisburg Light & Power Company, Harrisburg, Pennsylvania.

Kane, Joseph P., March, 1907. (P)
Superintendent, Westchester Lighting Company, 130 North Main Street, Port Chester, New York.

Keal, George I., September, 1911.
Superintendent of Construction, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Keegan, Chas. F., September, 1908. (P)
Superintendent, 21st Street Station, Consolidated Gas Company of New York, 501 East 21st Street, New York, New York.

Keene, Alfred M., October, 1906.
Comptroller, Westchester Lighting Company, 1st Avenue and 1st Street, Mount Vernon, New York.

Keillor, John, March, 1907.
Dominion Tar & Ammonia Company, Ltd., 220 Lister Building, Hamilton, Ontario, Canada.

Keller, C. M., October, 1906. (P)
President, Columbus Gas Light Company, 312 Washington Street, Columbus, Indiana.

Kelley, William D., September, 1912. (P)
General Superintendent of Meters, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Kellogg, Leonard L., October, 1906. (P)
President, Sioux City Gas & Electric Company, 509 Pierce Street, Sioux City, Iowa.

Kellogg, Raymond C., March, 1909. (P)
Assistant to Superintendent of Street Department, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Kellogg, R. M., October, 1906. (P)
Assistant Engineer, Westchester Lighting Company, Mount Vernon, New York.

Kelsey, Charles B., September, 1912.
President, American Public Utilities Company, Michigan Trust Building, Grand Rapids, Michigan.

Kendall, Albert Whittemore, March, 1910.
Assistant Manager, Rockford Gas Light & Coke Company, 201 Mulberry Street, Rockford, Illinois.

Kennedy, James, September, 1907.
Agent, Gas and Electric Departments, Public Service Gas Company, 591 Spring Street, West Hoboken, New Jersey.

Kennedy, James S., October, 1906. (P)
Superintendent, Standard Gas Light Company, foot of East 115th Street, New York, New York.

Kennedy, John Pendleton, September, 1907. (P)
General Superintendent, Cambridge Gas Light Company, 354 Third Street, East Cambridge, Massachusetts.

Kennedy, Thomas P., March, 1911. (P)
Assistant Superintendent, Street Department, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Keppelman, John H., October, 1906.
Superintendent, Consumers Gas Company, 20 North Fifth Street, Reading, Pennsylvania.

Keppelmann, D. Ellwood, October, 1906. (P)
Superintendent of Gas Distribution, Pacific Gas & Electric Company, 445 Sutter Street, San Francisco, California.

Kersting, Albert F., October, 1906.
Engineer, Mobile Gas Company, Box 234, Mobile, Alabama.

*King, Arthur Gordon, September, 1909. (P)
Department of Utilization, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Kingsbury, I. C., March, 1909. (P)
Superintendent of Street Department, Consolidated Gas Company of New York, 80 Elizabeth Street, New York, New York.

KIRCHER, HARRY B., March, 1907.
501 Railroad Avenue, Spokane, Washington.

KLEIN, AUGUST CLARENCE, September, 1912. (P)
Engineer, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

KLUMPP, JOHN BARTLEMAN, October, 1906. (P)
Inspecting Engineer, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

KNAPP, AMOS M., October, 1906. (P)
Foreman of Meter Shop, Westchester Lighting Company, 266 Woodworth Avenue, Yonkers, New York.

KNAPP, ISAAC N., October, 1906. (P)
116 Ardmore Avenue, Ardmore, Pennsylvania.

KNAPP, WALTER RAY, September, 1914. (N)
Superintendent, North Shore Gas Company, 758 Genesee Street, Waukegan, Illinois.

KNAPP, WILLIAM JARED, March, 1910.
Assistant Superintendent, Division Street Station, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

KNIGHT, J. J., October, 1906.
Vice-President, Kalamazoo Gas Company, 123 West Street, Kalamazoo, Michigan.

KNOWLES, WILLIAM P., October, 1906. (P)
Superintendent, Richmond City Gas Works, 2606 Grove Avenue, Richmond, Virginia.

KOHLER, ALBERT J., September, 1913.
Superintendent, Light and Power Department, Lynchburg Traction & Light Company, 523 Main Street, Lynchburg, Virginia.

KOINER, C. W., October, 1906.
General Manager and Engineer, Municipal Lighting Plant, Pasadena, California.

KOWALKE, OTTO L., September, 1909.
Associate Professor Chemical Engineering, Engineering Building, University of Wisconsin, Madison, Wisconsin.

KRAFT, R. P., October, 1906.
Assistant Engineer, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

KRUMREY, ROBERT GARFIELD, September, 1913.
General Superintendent, Beloit Water, Gas & Electric Company, 429 East Grand Avenue, Beloit, Wisconsin.

KUBO, SHOSUKE, September, 1911.
Managing Director of Kobe Gas Company, Ltd., Kobe, Japan.

KUNZE, WALTER WILLIAM, March, 1914. (N) (P)
Engineer's Assistant, Brooklyn Union Gas Company, 556 Kent Avenue, Brooklyn, New York.

KUSTER, JOHN D., September, 1912.
Manager San Jose District, Pacific Gas & Electric Company, 2nd and Antonio Streets, San Jose, California.

LAMBERT, EDW. L., September, 1909.
General Manager, Cedar Rapids Gas Light Company, 3d and 4th Avenues, Cedar Rapids, Iowa.

LAMSON, CHARLES DUDLEY, October, 1906.
President and General Manager, Worcester Gas Light Company, 240 Main Street, Worcester, Massachusetts.

LAMSON, WILLIAM O., JR., March, 1907. (P)
Manager, Chester County Gas Company, 33 West Gay Street, West Chester, Pennsylvania.

LANE, FREDERICK K., October, 1906.
Manager and Treasurer, Seattle Lighting Company, Seattle, Washington.

LANE, JAS. M., September, 1909. (P)
Superintendent of Works, Public Service Gas Company, Paterson, New Jersey.

LANE, WILLIAM P., March, 1908. (P)
Superintendent, Point Breeze Works, United Gas Improvement Company, Passyunk Avenue and Schuylkill River, Philadelphia, Pennsylvania.

LARAWAY, B. R., September, 1908.
Treasurer and General Manager, Jackson Gas Company, Jackson, Michigan.

LATHROP, ALANSON P., October, 1906. (P)
President, American Light & Traction Company, 40 Wall Street, New York, New York.

LAVELLE, WILLIAM J., March, 1913. (P)
Manager Coke Sales Department, New England Coal & Coke Company, 111 Devonshire Street, Boston, Massachusetts.

LAWLOR, JAS. W., September, 1908.
Superintendent North Station, Peoples Gas Light & Coke Company, 1122 Crosby Street, Chicago, Illinois.

LAWLOR, R. H., October, 1906.
Manager, Indiana Gas Light Company, 74 E. Maple Street, Noblesville, Indiana.

Lawrence, W. F., October, 1906. (P)
Superintendent of Manufacture, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

Lea, Henry I., October, 1906. (P)
Consulting Gas Engineer, Peoples Gas Building, Chicago, Illinois.

Leach, F. A., Jr., September, 1912.
Oakland District Manager, Pacific Gas & Electric Company, Post Office Box 426, Oakland, California.

Learned, Charles A., October, 1906. (P)
General Manager, Meriden Gas Light Company, 33 Colony Street, Meriden, Connecticut.

Learned, Waldo A., October, 1906.
General Superintendent, Newton and Watertown Gas Light Company, 308 Washington Street, Newton, Massachusetts.

Leland, Edw. D., September, 1909.
Superintendent of Compressing Stations, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

Leonard, Charles F., October, 1906. (P)
Engineer, 220 Broadway, New York, New York.

Letang, B. E., October, 1906.
Proprietor, Jackson Gas Light Company, Jackson, California.

Lewis, Raymond Chapin, March, 1911.
Care of Sherman & Stalter Company, Seneca Falls, New York.

Lewis, William Morgan, October, 1906.
Rockville Gas Company, 7 Park Street, Rockville, Connecticut.

Light, Edward H., October, 1906.
Superintendent of Distribution, Dayton Gas Light & Coke Company, 203 East First Street, Dayton, Ohio.

Light, George, October, 1906.
Superintendent, Dayton Gas Light & Coke Company, 203 East First Street, Dayton, Ohio.

Lillie, Lewis, October, 1906.
Third Vice-President and Treasurer, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Lindsay, Robert, October, 1906. (P)
Superintendent Gas Department, New Bedford Gas & Edison Light Company, 214 South Water Street, New Bedford, Massachusetts.

Linton, Samuel E., Jr., October, 1906.
Superintendent, Sioux Falls Gas Company, Sioux Falls, South Dakota.

LITTLE, ARTHUR DEHON, March, 1908.
President, Arthur D. Little, Inc., 93 Broad Street, Boston, Massachusetts.

LITTLE, A. S. B., September, 1914.
Gas Engineer to State Commission, State Public Utilities Commission, Odd Fellows Building, Springfield, Illinois.

LITTLEHALES, THOMAS, October, 1906.
Garden Hotel, Camden, New Jersey.

LIVINGSTON, H., March, 1909. (P)
Assistant Superintendent Point Breeze Gas Works, The United Gas Improvement Company, Passyunk Avenue and Schuylkill River, Philadelphia, Pennsylvania.

LIVINGSTON, ROBERT E., September, 1911. (P)
Advertising Manager, Consolidated Gas Company, 1 Madison Avenue, New York, New York.

LLOYD, ALFRED G., October, 1906.
Vice-President, Adrian (Mich.) Gas Company, 860 Greenwood Avenue, Detroit, Michigan.

LLOYD, ERNEST F., October, 1906. (P)
President, Delphos Gas Company, 860 Greenwood Avenue, Detroit, Michigan.

LONG, DAVID SAMUEL, March, 1913.
Meter Department, Gas Company, 218 West Ashley Street, Jacksonville, Florida.

LOVE, EDWARD GURLEY, March, 1913. (P)
Chief Chemist, Consolidated Gas Company, 130 East 15th Street, New York, New York.

LOW, D. W., October, 1906.
Superintendent, Alliance Gas & Electric Company, Alliance, Ohio.

LUCAS, THOMAS J., September, 1911. (P)
Consulting Engineer, Assistant to W. A. Baehr, 2009 Peoples Gas Building, Chicago, Illinois.

LUCENA, JOSEPH, October, 1906.
Superintendent of Distribution, Omaha Gas Company, 1202 Howard Street, Omaha, Nebraska.

LUCKE, CHARLES EDWARD, September, 1913.
Professor, Department of Mechanical Engineering, Columbia University, Morningside Heights, New York, New York.

LUCKENBACH, CHARLES A., September, 1911.
Manager of Construction, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Luick, Adolph James, September, 1913. (P)
Assistant Consulting Engineer with W. A. Baehr, 2009 Peoples Gas Building, Chicago, Illinois.

Lundblad, Oscar J. A., March, 1911. (P)
Superintendent, Nassau & Suffolk Lighting Company, Washington Avenue, Hempstead, New York.

Lundgaard, I., March, 1913.
Industrial Engineer, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

Luqueer, Robert Orr, October, 1906. (P)
Secretary, Humphreys & Miller, Inc., 165 Broadway, New York, New York.

Luther, F. E., October, 1906.
Superinendent, Peoples Gas Light & Coke Company, Michigan Avenue and Adams Street, Chicago, Illinois.

Luther, William J., October, 1906. (P)
Superintendent, Attleboro Gas Light Company, 19 Dunham Street, Attleboro, Massachusetts.

Lydecker, Fredk. Ackerman, March, 1913. (P)
Assistant Superintendent of Distribution, Public Service Gas Company, Spring and Water Streets, Morristown, New Jersey.

Lynn, James T., October, 1906.
President, National Gas, Electric Light & Power Company, Ford Building, Detroit, Michigan.

Lyon, Chas. Lumsden, October, 1906.
Superintendent, St. Augustine Gas & Electric Light Company, St. Augustine, Florida.

Lyons, B. F., October, 1906. (P)
Vice-President and General Manager, Beloit Water, Gas & Electric Company, 429 East Grand Avenue, Beloit, Wisconsin.

McAdam, Bryce, October, 1906.
Superintendent of Distribution, Milwaukee Gas Light Company, 406 Bradford Avenue, Milwaukee, Wisconsin.

McCallum, J. N., October, 1906.
Vice-President, Lenawee County Gas & Electric Company, Adrian, Michigan, 39 South La Salle Street, Chicago, Illinois.

McCarter, Thos. N., September, 1907.
President, Public Service Gas Company, Broad and Bank Streets, Newark, New Jersey.

McCarthy, J. M., March, 1909.
Vice-President, American Light & Traction Company, 40 Wall Street, New York, New York.

McClary, N. A., October, 1906.
President, Northwestern Gas Light Company, 108 La Salle Street, Chicago, Illinois.

McClellan, William, September, 1913. (P)
Consulting Gas Engineer, 141 Broadway, New York, New York.

McClellon, J. M., March, 1911.
Superintendent, New England Gas & Coke Company, Everett, Massachusetts.

McCloy, Walter L., September, 1909. (P)
General Superintendent, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

McCorkindale, William J., October, 1906. (P)
General Manager, Wilmington Gas Company, Wilmington, Delaware.

McCrea, Thomas P., March, 1913.
Assistant Secretary, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

McDonnell, Charles, September, 1914. (N)
Superintendent Gas Works, Quincy Gas, Electric & Heat Company, 422 Maine Street, Quincy, Illinois.

McDonald, Donald, October, 1906.
Vice-President and General Manager, Louisville Gas & Electric Company, 311 West Chestnut Street, Louisville, Kentucky.

McDonald, Donald, October, 1906.
With D. McDonald & Company, 991 Broadway, Albany, New York.

McDonald, William, October, 1906. (P)
With D. McDonald & Company, 991 Broadway, Albany, New York.

McDowell, J. C., March, 1907.
General Manager, Kansas Natural Gas Company, Farmers' Bank Building, Pittsburgh, Pennsylvania.

McGowan, Henry Eddy, March, 1911. (P)
General Manager, The Flatbush Gas Company, 176 Remsen Street, Brooklyn, New York.

McGraw, Isaac, March, 1914. (N) (P)
Superintendent, New York Mutual Gas Light Company, 825 East 11th Street, New York, New York.

McGregor, William, October, 1906.
Manager, The Pawtucket Gas Company, 231 Main Street, Pawtucket, Rhode Island.

McGURTY, WILLIAM J., March, 1912. (P)
Assistant Superintendent, Central Union Gas Company, 905 East 138th Street, New York, New York.

McILHENNY, JAMES S., October, 1906.
Engineer, Washington Gas Light Company, 413 10th Street, N. W., Washington, District of Columbia.

McILHENNY, JOHN, October, 1906. (P)
Consulting Engineer, Washington (D. C.) Gas Light Company, 1339 Cherry Street, Philadelphia, Pennsylvania.

McILHENNY, JOHN D., October, 1906. (P)
Managing Director, Portsmouth (Va.) Gas Company, 1339 Cherry Street, Philadelphia, Pennsylvania.

McINTYRE, ANDREW, September, 1908.
Superintendent, Public Service Company of Northern Illinois, University and Maple Avenues, Evanston, Illinois.

McKAY, WILLIAM E., October, 1906. (P)
Vice-President and General Manager, New England Gas & Coke Company, 111 Devonshire Street, Boston, Massachusetts.

McKEE, G. W., October, 1906.
Vice-President and Manager, Eclipse Fuel Engineering Company, 100 Forbes Street, Rockford, Illinois.

McKENZIE, W. H., October, 1906.
General Manager, Wyandotte County Gas Company, 6th Street and Minnesota Avenue, Kansas City, Kansas.

McLEAN, GEORGE, October, 1906.
President and Manager, The Key City Gas Company, 669 Main Street, Dubuque, Iowa.

McLEAN, H. B., March, 1908. (P)
General Superintendent, Gas Appliance Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

McMILLIN, EMERSON, October, 1906.
40 Wall Street, New York, New York.

McMILLIN, MARION, March, 1909.
Assistant Secretary, American Light & Traction Company, 40 Wall Street, New York, New York.

McQUESTON, WILLIAM MORTON, March, 1914. (N)
Superintendent Gas Works, Lawrence Gas Company, 34 Marston Street, Lawrence, Massachusetts.

MACARTHUR, DONALD, September, 1913. (P)
Superintendent of Manufacture, Laclede Gas Light Company, Laclede Gas Building, St. Louis, Missouri.

MACBETH, A. B., October, 1906.
Hotel Alexandria, Los Angeles, California.

MACBETH, GEORGE T., October, 1906. (P)
Engineer, Gas Department, Westchester Lighting Company, First Avenue and First Street, Mount Vernon, New York.

MACDONALD, GEORGE, October, 1906.
President and General Manager, Nassau and Suffolk Lighting Company of Freeport, New York, 149 Broadway, New York, New York.

MACINTOSH, WALTER L., March, 1909. (P)
Chief Draftsman, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

MACKIE, G. W., September, 1913. (P)
Assistant Superintendent, Milwaukee Coke & Gas Company, Colby-Abbott Building, Milwaukee, Wisconsin.

MACKLIN, A. FRED, September, 1911. (P)
Engineer's Assistant, Manufacturing Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

MACLEOD, DANIEL TATE, March, 1914. (N)
Engineer, Otto Coking Company, 6 Church Street, New York, New York.

MACSWEENEY, JOSEPH P., March, 1911. (P)
Assistant Commercial Agent, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

MACY, CARLTON, October, 1906.
President, Queens Borough Gas & Electric Company, 345 Central Avenue, Far Rockaway, New York.

MAINLAND, SINCLAIR, October, 1906.
Treasurer, Continental Public Utilities Company, Oshkosh, Wisconsin.

MAINLAND, WILLIAM, October, 1906.
President, Continental Public Utilities Company, Oshkosh, Wisconsin.

MALONE, M. E., October, 1906.
Manager Coke Department, Denver Gas & Electric Company, 900 15th Street, Denver, Colorado.

MALONEY, ANDREW P., September, 1907.
Official of Gas Companies, Lakewood (N. J.) Gas Company, 2116 Venango Street, Philadelphia, Pennsylvania.

MALONEY, MARTIN 2D, March, 1913.
Assistant to Superintendent, City Gas Light Company, Post Office Apartments, Ocean City, New Jersey.

Manly, Fred G., September, 1914. (N)
Superintendent, Peoples Gas Light & Coke Company, 2250 South Racine Avenue, Chicago, Illinois.

Mann, Howard E., October, 1906. (P)
Engineer, Montreal Light, Heat & Power Company, Montreal, Canada.

Mansfield, Joseph Hugh, March, 1914.
Superintendent, Department of Mains and Services, Consolidated Gas Company of New York, 300 West 66th Street, New York, New York.

Manson, D. Edgar, September, 1914. (N)
Vice-President, Charles H. Tenney & Company, 201 Devonshire Street, Boston, Massachusetts.

Markhus, O. G. F., October, 1906.
Engineer, Idaho-Oregon Light & Power Company, Boise, Idaho.

Markley, Joseph C., October, 1906.
Chief Engineer, Metropolitan Gas & Electric Company, 111 West Monroe Street, Chicago, Illinois.

Marks, R. J., October, 1906.
Superintendent, City Gas Company, Norfolk, Virginia.

Marrow, George Peek, September, 1910. (P)
Engineer, Gas Engineer's Department, Consolidated Gas, Electric Light & Power Company, Lexington and Liberty Streets, Baltimore, Maryland.

Marshall, F. L., October, 1906. (P)
Manager, Gas Light Company of Augusta, 809 Broad Street, Augusta, Georgia.

Marshall, William H., October, 1906.
Assistant to Third Vice-President, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Martin, Edmund H., September, 1908.
Commercial Agent, Des Moines Gas Company, 412 West 7th Street, Des Moines, Iowa.

Martin, Eugene S., September, 1909. (P)
Superintendent, Westchester Lighting Company, Mamaroneck Avenue, White Plains, New York.

Martin, John, October, 1906.
President, Coast Counties Light & Power Company, 454 California Street, San Francisco, California.

Martin, John Gordon, September, 1912.
Manager, Gas & Electric Light Company, 19 East Washington Street, Greencastle, Indiana.

MARTIN, WILLIAM PAUL, March, 1908.
Vice-President, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

MASON, JOHN T., October, 1906.
Superintendent Third Ward Works, Milwaukee Gas Light Company, 129 25th Street, Milwaukee, Wisconsin.

MATHER, JOHN L., September, 1908.
General Manager, Counties Gas & Elecric Company, Ardmore, Pennsylvania.

MATHEWS, EUGENE HAMILTON, September, 1908. (P)
Superintendent, Citizens' Works, Brooklyn Union Gas Company, 5th and Hoyt Streets, Brooklyn, New York.

MATLACK, WILLIAM H., JR., March, 1914. (N)
Superintendent, Henrico County Gas Company, 900 North Avenue, Richmond, Virginia.

MAXON, J. H., October, 1906.
General Manager, Central Indiana Gas Company, Muncie, Indiana.

MAYER, JOSEPH, September, 1914. (N)
President, The Coast Gas Company, Belmar, New Jersey.

MAYERS, J. ALEX., October, 1906. (P)
Gas Engineer; President, Public Service Construction Company, 30 Broad Street, New York, New York.

MEAD, GILES W., September, 1908. (P)
President, Indiana Natural Gas & Oil Company, The Linde Air Products Company, 42d Street Building, New York, New York.

MELICK, THOS. L., September, 1907. (P)
Engineer, Central Division, Public Service Gas Company, 249 East 4th Street, Plainfield, New Jersey.

MERCHANT, O. A., JR., March, 1907.
Manager, Bangor Gas Light Company, 18 Central Street, Bangor, Maine.

MERRITT, ALBERT H., October, 1906. (P)
General Manager, Niagara Falls Gas & Electric Light Company, 306 Niagara Street, Niagara Falls, New York.

MERRITT, W. H., October, 1906.
General Manager, Fremont Gas, Electric Light & Power Company, Freemont, Nebraska.

MIDDLETON, ROBERT L., October, 1906.
1530 30th Street, N. W., Washington, District of Columbia.

MILLARD, FREDERICK CHAS., September, 1907.
Consulting Gas Engineer, 425 Merchants Trust Building, Los Angeles, California.

MILLER, ALTEN S., October, 1906. (P)
Vice-President, Humphreys & Miller, Inc., 165 Broadway, New York, New York.

MILLER, CARROLL, October, 1906. (P)
General Manager and Engineer, Western United Gas & Electric Company, Aurora, Illinois.

MILLER, C. O. G., October, 1906.
President, Pacific Lighting Company, 519 California Street, San Francisco, California.

MILLER, COMMODORE RUSSELL, September, 1914. (N)
Gas Engineer, American Gas Utilities Company, 1124 Healey Building, Atlanta, Georgia.

MILLER, H. C., September, 1913.
Secretary and Treasurer, Northern Indiana Gas & Electric Company, Hammond, Indiana.

MILLER, ROBT. C., September, 1909.
Assistant Superintendent, Coke Department, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

MILLER, ROBERT S., October, 1906.
Manager, Jackson County Light, Heat & Power Company, 210 West Maple Avenue, Independence, Missouri.

MILLER, THOMAS DAVID, October, 1906. (P)
Special Representative for E. M. Mancourt, Western Manager, The Consolidation Coal Company, 910 Fisher Building, Chicago, Illinois.

MILLER, V. A., September, 1907.
Superintendent and New Business Manager, Canandaigua Gas Light Company, 66 South Main Street, Canandaigua, New York.

MILLER, WILLIAM A., October, 1906.
Engineer of Construction and Operation, National Chamber Oven Company, 2315 Krouse Avenue, Cincinnati, Ohio.

MILNE, DAVID S., October, 1906.
Division Manager, Central Indiana Gas Company, Marion, Indiana.

MILLS, SAMUEL ARCHIBALD, March, 1911. (P)
Assistant Superintendent, Williamsburg Works, Brooklyn Union Gas Company, Foot of North 12th Street, Brooklyn, New York.

MILTON, MARSHALL M., September, 1912.
Manager, Roanoke Gas Light Company, Roanoke, Virginia.

MITCHELL, CURTIS S., September, 1914. (N) (P)
Controller, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

MITCHELL, H. J., September, 1914. (N)
District Manager, Western United Gas & Electric Company, 208 North Ottawa Street, Joliet, Illinois.

MOCKETT, W. E., October, 1906.
Chief Engineer, Gas Deparment, Havana Electric Railway, Light & Power Company, Monte No. 1, Havana, Cuba.

MONTGOMERY, JOHN E., September, 1914. (N)
Superintendent, Gas Department, Birmingham Railway, Light & Power Company, 2100 First Avenue, Birmingham, Alabama.

MOORE, EDWIN A., March, 1908.
President, American Coke & Gas Construction Company, Camden, New Jersey; 2216 North 52d Street, Philadelphia, Pennsylvania.

MOORE, H. M., October, 1906.
Manager, The Crookston Gas Company, 212 North Broadway, Crookston, Minnesota.

MOORHOUSE, LOUIS B., September, 1908.
Care of H. L. Doherty & Company, 60 Wall Street, New York, New York.

MOREHEAD, JOHN M., October, 1906. (P)
Consulting Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

MORGAN, JOHN EYRE, October, 1906.
Superintendent, Gas Works, Pawtucket Gas Company, 91 Summit Street, Pawtucket, Rhode Island.

MORRELL, EDWARD E., October, 1906. (P)
Treasurer, National Gas & Water Company, 184 La Salle Street, Chicago, Illinois.

MORRIS, HENRY CHARLES, September, 1912.
General Manager, Dallas Gas Company, Dallas, Texas.

MORRIS, ROBERT C., JR., October, 1906. (P)
200 South High Street, Bethlehem, Pennsylvania.

MORRIS, W. CULLEN, October, 1906. (P)
Engineer of Construction, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Morris, William Giles, March, 1911. (P)
Chief Clerk, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Morris, William T., October, 1906.
President and Treasurer, United States Gas & Electric Company, Penn Yan, New York.

Morrison, Henry K., October, 1906. (P)
General Manager, Lynn Gas & Electric Company, 90 Exchange St., Lynn, Massachusetts.

Morse, Edward R., September, 1914. (N)
Superintendent, Peoples Gas & Electric Company, Oswego, New York.

Morton, Albert B., September, 1907.
Superintendent, Rome Gas, Electric Light & Power Company, 139 North James Street, Rome, New York.

Morton, F. N., October, 1906. (P)
Engineer, with United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Moses, Frank D., October, 1906.
Engineer, Gas Engineering Company, 7 North Stockton Street, Trenton, New Jersey.

Mueller, M. E., September, 1909. (P)
Assistant Superintendent of Manufacture, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

Mulholland, S. E., October, 1906. (P)
Assistant General Manager, Indiana Lighting Company, 1117 West Jefferson Street, Fort Wayne, Indian..

Munson, Ralph Ira, March, 1912. (P)
Secretary, Bridgeport Gas Light Company, 799 Main Street, Bridgeport, Connecticut.

Murdock, James W., October, 1906.
General Superintendent, Underlying Companies, Associated Gas & Electric Company, Ithaca, New York.

Murdock, S. T., October, 1906.
Secretary and General Manager, Indiana Lighting Company, 4th and Ferry Streets, Lafayette, Indiana.

Murphy, Edward J., September, 1913. (P)
Assistant Chemist, Brooklyn Union Gas Company, 5th and Hoyt Streets, Brooklyn, New York.

Murray, John J., March, 1911.
Superintendent, Allegheny Heating Company, 435 6th Avenue, Pittsburgh, Pennsylvania.

MYERS, EDWARD BRITTAIN, October, 1906.
Engineer, Northern Indiana Gas & Electric Company, 215 South Michigan Street, South Bend, Indiana.

MYERS, JOSEPH B., October, 1906. (P)
Commercial Agent, The United Gas Improvement Company, 1035 Market Street, Philadelphia, Pennsylvania.

NAPHTALY, SAMUEL L., October, 1906.
Engineer, Operation and Maintenance, Pacific Gas & Electric Company, 445 Sutter Street, San Francisco, California.

NELSON, JOHN F., March, 1909. (P)
Superintendent of Mains and Services, Consolidated Gas Company of New York, 111th Street and 1st Avenue, New York, York.

NETTLES, ROSCO, September, 1911. (P)
Secretary, Tampa Gas Company, Tampa, Florida.

NETTLETON, CHARLES H., October, 1906.
President, Derby Gas Company and New Haven Gas Light Company, 22 Elizabeth Street, Derby, Connecticut.

NEVANAS, HAROLD HONEY, March, 1914. (N) (P)
General Coal Gas Foreman, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

NEWBERRY, F. E., October, 1906.
584 South Chicago Avenue, Kankakee, Illinois.

NICHOLS, WILLIAM B., September, 1912.
Assistant General Manager, Citizens Gas Light Company, 11 Granite Street, Quincy, Massachusetts.

NICKERSON, FRANKLIN HEZEKIAH, March, 1911. (P)
Chief Statistician, Consolidated Gas Company, 130 East 15th Street, New York, New York.

NORCROSS, J. ARNOLD, October, 1906. (P)
Secretary and Treasurer, New Haven Gas Light Company, 80 Crown Street, New Haven, Connecticut.

NORRIS, ROLLIN, October, 1906.
General Superintendent, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

NORTH, EDWIN, March, 1910. (P)
Purchasing Agent, Consolidated Gas Company, 130 East 15th Street, New York, New York.

NORTON, WALTER F., October, 1906. (P)
Superintendent, Gas Department, Nashua Light, Heat & Power Company, 70 East Pearl Street, Nashua, New Hampshire.

Norton, William J., September, 1913.
Special Consulting Work, Public Service Company of Northern Illinois, Middle West Utilities Company of Illinois, 111 West Monroe Street, Chicago, Illinois.

Nute, Joseph E., October, 1906.
Manager, Fall River Gas Works Company, 155 North Main Street, Fall River, Massachusetts.

O'Connell, John, March, 1913.
General Foreman of Gas Making, Consolidated Gas Company, 501 East 21st Street, New York, New York.

O'Donnell, Chas. J., April, 1908. (P)
Assistant to Engineer of Tests, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Odrich, Erich, September, 1914. (N)
Engineer and Manager, Manila Gas Corporation, Manila, Philippine Islands.

Offutt, M. Webb, March, 1908. (P)
Engineer, Care of Engineers' Club, 32 West 40th Street, New York, New York.

Okamoto, Sakura, March, 1909.
Chief Engineer and Manager, Nagoya Gas Company, Nagoya, Japan.

Olds, Howard L., October, 1906.
Assistant Vice-President, Middle West Utilities Company, 112 West Adams Street, Chicago, Illinois.

Olmsted, George G., October, 1906.
105 South LaSalle Street, Chicago, Illinois.

Olsen, Edward, September, 1914. (N)
Superintendent of Manufacture, Benton Harbour–St. Joseph Gas & Fuel Company, 211 Lake Avenue, Benton Harbour, Michigan.

O'Malley, Patrick, October, 1906.
Engineer, Western United Gas & Electric Company, 95 Prairie Street, Aurora, Illinois.

Osborn, Arthur H., March, 1914. (N)
President, City Gas Light Company, 11th and Haven Avenues, Ocean City, New Jersey.

Osthoff, Otto E., October, 1906.
Vice-President and Chief Engineer, H. M. Byllesby & Company, Insurance Exchange Building, Chicago, Illinois.

Otten, Charles, Jr., March, 1907.
Superintendent, Haverhill Gas Light Company, 28 Washington Square, Haverhill, Massachusetts.

Owens, John, September, 1914. (N)
Superintendent of Manufacture and Distribution, Glens Falls Gas & Electric Light Company, 31 Warren Street, Glans Falls, New York.

Page, Carter H., Jr., October, 1906.
250 Juniper Street, Atlanta, Georgia.

Paige, Clifford E., March, 1909. (P)
Manager, Malden & Melrose Gas Light Company, 137 Pleasant Street, Malden, Massachusetts.

Palmer, A. J., March, 1909. (P)
Superintendent of Works, Bridgeport Gas Light Company, Howard Avenue Works, Bridgeport, Connecticut.

Palmer, E. H., October, 1906. (P)
President, Auburn Gas Company, Seneca Falls & Waterloo Gas Light Company, Geneva, New York.

Palmer, Harry C., October, 1906. (P)
Engineer, Buffalo Gas Company, 186 Main Street, Buffalo, New York.

Papst, Hilmar Maximilian, March, 1911.
General Manager, Portland Gas & Coke Company, 5th and Yamhill Streets, Portland, Oregon.

Parcher, Samuel L., September, 1912.
Superintendent of Gas Department, York Light & Heat Company, 233 Main Street, Biddeford, Maine.

Park, Frederick Edwin, March, 1914. (N)
Superintendent Anhydrous Ammonia Plant, Union Stock Yards, Morris & Company, Chicago, Illinois.

Parker, Frank H., October, 1906. (P)
Manager, Burlington Light & Power Company, 102 South Winooski Avenue, Burlington, Vermont.

Parker, Joseph Smith, October, 1906.
Superintendent, Frankford District, United Gas Improvement Company, 4427 Frankford Avenue, Philadelphia, Pennsylvania.

Parker, Richard Marsh, October, 1906.
General Manager, Fort Dodge Gas & Electric Company, 24 South 9th Street, Fort Dodge, Iowa.

Parkhurst, George W., September, 1914. (N) (P)
Secretary, New York Mutual Gas Light Company, 36 Union Square, New York, New York.

Parshall, A., March, 1913.
Consulting Engineer, Appraising Properties of Gas and Electric Companies, New York Athletic Club, Central Park South, New York, New York.

Partridge, Warren, September, 1909.
Penn Public Service Company, Clearfield, Pennsylvania.

Patt, Everett I., March, 1914. (N)
Superintendent, Pawtucket Gas Company, 231 Main Street, Pawtucket, Rhode Island.

Patten, J. A., October, 1906.
General Manager, Elkhart Gas & Fuel Company, Elkhart, Indiana.

Payne, A. I., October, 1906.
Consulting Gas Engineer, Post Office Box 571, Calgary, Alberta, Canada.

Pearson, J. A., October, 1906.
Purchasing Agent, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Pearson, W. H., October, 1906.
34 North Sherbourne Street, Toronto, Ontario, Canada.

Peck, Henry W., March, 1912. (P)
Vice-President and General Manager, Mohawk Gas Company, 511 State Street, Schenectady, New York.

Peebles, Edwin C., March, 1914. (N)
General Manager, Rockland Light & Power Company, 2 North Broadway, Nyack, New York.

Pelton, Bert F., October, 1906.
Superintendent Gas Distribution, St. Paul Gas Light Company, 6th and Jackson Streets, St. Paul, Minnesota.

Penington, Dudley W., March, 1912.
Assistant Superintendent, South Division, Street Department, Peoples Gas Light & Coke Company, 38 West 64th Street, Chicago, Illinois.

Perkins, Benjamin W., October, 1906. (P)
General Manager, Hartford City Gas Light Company, 565 Main Street, Hartford, Connecticut.

Perkins, Jay Hugh, October, 1906.
Consulting Electrical Engineer, United Gas & Electric Engineering Corporation, 61 Broadway, New York, New York.

Perry, Joseph A., October, 1906. (P)
Assistant to General Superintendent, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

PETTES, W. H., October, 1906. (P)
General Auditor, Public Service Gas Company, Post Office Box 590, Newark, New Jersey.

PHILBRICK, JOSEPH E., September, 1911.
General Manager, York Gas Company, 127 West Market Street, York, Pennsylvania.

PIPKIN, JESSE E., September, 1913. (P)
Superintendent, Station B, Laclede Gas Light Company, Laclede Gas Building, St. Louis, Missouri.

PLANK, D. C., September, 1914. (N)
Manager, Missoula Gas Company, 126 West Main Street, Missoula, Montana.

PLUMMER, H. W., October, 1906.
Manager, Asheville Power & Light Company, Asheville, North Carolina.

POLK, ROGER W., October, 1906. (P)
Consulting Gas Engineer, 193 Washington Avenue, Providence, Rhode Island.

POLLITT, L. IRVING, October, 1906.
Vice-President and General Manager, Southern Gas & Electric Corporation, 213 Courtland Street, Baltimore, Maryland.

PORTER, EDWARD, September, 1913. (P)
Special Accountant, General Auditor's Department, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

PORTER, JOSEPH F., October, 1906.
President, Tri-City Railway & Light Company, Davenport, Iowa.

POTTER, ORMSBY F., March, 1914. (N) (P)
Assistant to General Auditor, Public Service Gas Company, Broad and Bank Streets, Newark, New Jersey.

POWELL, DAVID A., September, 1909.
Engineer's Assistant, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

POWELL, WILLIAM R., October, 1906.
Superintendent, Columbus Gas & Fuel Company, 135 North Front Street, Columbus, Ohio.

PRATT, CHARLES OLAND, March, 1914. (N)
Superintendent of Construction, Portland Gas Light Company, 40 West Commercial Street, Portland, Maine.

PRATT, EDWARD G., October, 1906. (P)
Consulting Gas Engineer and President, Boone (Iowa) Gas Company, 627 Peoples Gas Building, Chicago, Illinois.

Prichard, Chas. R., September, 1909. (P)
Superintendent, Beverly Gas & Electric Company, Beverly, Massachusetts.

Priest, George Heywood, March, 1910. (P)
Gas Engineer, Stone & Webster Engineering Corporation, 147 Milk Street, Boston, Massachusetts; R. F. D., Framingham, Massachusetts.

Printz, Charles H., October, 1906.
Vice-President, Gas Machinery Company, 1900 Euclid Avenue, Cleveland, Ohio.

Purcell, Theo. V., October, 1906. (P)
Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Putnam, William R., October, 1906.
New Business Manager, Utah Power & Light Company, Kearns Building, Salt Lake City, Utah.

Quackenbush, Charles H., October, 1906.
Manager, St. Clair County Gas & Electric Company, 414 Missouri Avenue, East St. Louis, Illinois.

Quinn, Andrew K., October, 1906. (P)
President, Newport Gas Light Company, 181 Thames Street, Newport, Rhode Island.

Raabe, Charles, March, 1910. (P)
Assistant to Superintendent, Consolidated Gas Company, 501 East 21st Street, New York, New York.

Rafferty, James Aloysius, September, 1910.
Assistant Superintendent, Peoples Gas Light & Coke Company, 1122 Crosby Street, Chicago, Illinois.

Rahn, Bruno, March, 1914. (N)
Engineering Department, Milwaukee Gas Light Company, 182 Wisconsin Street, Milwaukee, Wisconsin.

Ramsburg, Charles J., October, 1906. (P)
Second Vice-President, H. Koppers Company, 5 South Wabash Avenue, Chicago, Illinois.

Ramsdell, George G., October, 1906. (P)
Secretary and Treasurer, American Gas Institute, 29 West 39th Street, New York, New York.

Randolph, William W., October, 1906. (P)
Consulting Engineer, Woolworth Building, 233 Broadway, New York, New York.

RAY, WILLIAM DANIEL, March, 1911.
Manager, Northern Indiana Gas & Electric Company, 571 Hohman Street, Hammond, Indiana.

REED, JAMES H., JR., September, 1909. (P)
General Purchasing Agent, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

REED, JOSEPH A., March, 1911.
Assistant General Superintendent, Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

REES, RICHARD, October, 1906.
Superintendent Bookkeeping Department, Peoples Gas Light & Coke Company, Michigan Avenue and Adams Street, Chicago, Illinois.

REESIDE, HOWARD S., March, 1914. (N)
President, Washington Gas Light Company, 413 10th Street, N. W., Washington, D. C.

REIMERS, FREDERICK WILLIAM, September, 1912.
General Manager, Natalbany Lumber Company, Hammond, Louisiana.

REINACH, HUGO B., March, 1911.
Assistant General Superintendent, Commercial Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

REINHARD, SOLON A., September, 1910.
Assistant Superintendent of Works, Peoples Gas Light & Coke Company, 1129 Dearborn Avenue, Chicago, Illinois.

REINICKER, CHARLES E., March, 1912. (P)
Assistant to Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

REITEMEYER, A. F., October, 1906. (P)
Secretary and Treasurer, Perth Amboy Gas Light Company, 196 Smith Street, Perth Amboy, New Jersey.

REW, IRWIN, October, 1906.
Vice-President, DeKalb County (Ill.) Gas Company, and Sterling (Ill.) Gas & Electric Company, 108 South LaSalle Street, Chicago, Illinois.

RHOADES, WILLIAM R., October, 1906.
General Manager, Northern Central Gas Company, Williamsport, Pennsylvania.

RICE, HENRY L., October, 1906. (P)
Consulting Engineer, First National Bank Building, Milwaukee, Wisconsin.

Richards, J. L., September, 1907.
President and General Manager, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

Richardson, Walter W., October, 1906.
President, Iroquois Natural Gas Company, 205 Iroquois Building, Buffalo, New York.

Richter, Arthur W., October, 1906.
Professor of Engineering, University of Montana, Bozeman, Montana.

Rieha, Edward L., October, 1906. (P)
Secretary, Sumter Gas & Power Company, Sumter, South Carolina; 213 Courtland Street, Baltimore, Maryland.

Riggins, John A., March, 1914. (N)
President, New Jersey Northern Gas Co., Court House Square Building, Camden, New Jersey.

Riselay, William S., October, 1906.
Secretary and Treasurer, Buffalo Gas Company and Peoples Gas Light & Coke Company, 186 Main Street, Buffalo, New York.

Ritter, Charles S., October, 1906.
Secretary and Assistant Treasurer, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Roberts, E. C., September, 1907.
Division Agent, Public Service Gas Company, 114 Main Street, Hackensack, New Jersey.

Roberts, F. M., October, 1906.
Manager, Haverhill Gas Light Company, 28 Washington Square, Haverhill, Massachusetts.

Roberts, George J., October, 1906.
First Vice-President, Public Service Gas Company, 759 Broad Street, Newark, New Jersey.

Roberts, Geo. W., March, 1909. (P)
Treasurer, Bridgeport Gas Company, 799 Main Street, Bridgeport, Connecticut.

Robison, Charles D., October, 1906. (P)
Consulting Engineer, Forstall & Robison, 84 William Street, New York, New York.

Rodgers, William Joseph, September, 1913.
Assistant Superintendent of Distribution, Public Service Gas Company, 2d and Cherry Streets, Camden, New Jersey.

Roeser, Charles J., September, 1907. (P)
Engineer, Bergen Division, Public Service Gas Company, 118 Main Street, Hackensack, New Jersey.

Rogers, Fred Alfred, September, 1913.
Secretary and General Manager, Watertown Light & Power Company, 137 Arsenal Street, Watertown, New York.

Rogers, John McClelland, September, 1908.
Assistant to Purchasing Agent, Public Service Gas Company, 759 Broad Street, Newark, New Jersey.

Rogers, W. H., October, 1906. (P)
Agent, Passaic Division, Public Service Gas Company, 188 Ellison Street, Paterson, New Jersey.

Roohan, Patrick F., October, 1906. (P)
Superintendent, Adirondack Electric Power Corporation, 491 Broadway, Saratoga Springs, New York.

Roper, George D., October, 1906. (P)
President, Eclipse Gas Stove Company, Vice-President, Boone (Iowa) Gas Company, Rockford, Illinois.

Rosenquest, Eugene H., October, 1906. (P)
President and General Manager, Bronx Gas & Electric Company, Walker and Frisbie Avenues, Westchester, New York.

Rosenthal, Albert, October, 1906.
General Contractor, Claiborne, Johnston & Company, 910 Garrett Building, Baltimore, Maryland.

Ross, J. Charles, October, 1906.
Care of Thomas West & Company, Perth Amboy, New Jersey.

Rossman, G. M., October, 1906.
Treasurer, Keene Gas & Electric Company, 18 Roxbury Street, Keene, New Hampshire.

Rowland, Charles L., October, 1906.
Consulting Engineer, American Welding Company, Carbondale, Pennsylvania.

Rowland, William L., October, 1906. (P)
Chemical Engineer, Henry Bower Chemical Manufacturing Company, 2815 Gray's Ferry Road, Philadelphia, Pennsylvania.

Royce, Frederick P., October, 1906.
Stone & Webster Management Association, 147 Milk Street, Boston, Massachusetts.

Ruegenberg, John M., March, 1907. (P)
Superintendent, Northern Liberties Gas Company, United Gas Improvement Company, 3d and Brown Streets, Philadelphia, Pennsylvania.

Runner, R. K., October, 1906.
Secretary and Manager, Gas Company, 709 Kelly Street, Charles City, Iowa.

Rusby, John M., October, 1906. (P)
Engineer of Tests, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Russell, Daniel R., October, 1906. (P)
President, D. R. Russell Engineering & Development Company, International Life Building, St. Louis, Missouri.

Russell, Herman, September, 1907. (P)
Superintendent of Gas Manufacturing, Rochester Railway & Light Company, 634 Averill Avenue, Rochester, New York.

Rutledge, Fred J., September, 1909.
Commercial Agent, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Sands, Howard T., March, 1913.
General Manager, Malden & Melrose Gas Light Company, 201 Devonshire Street, Boston, Massachusetts.

Sargeant, Frank Washburn, September, 1908.
Superintendent of Distribution, Citizens Gas Company, 31 South Pennsylvania Street, Indianapolis, Indiana.

Sargent, Fred H., October, 1906.
Assistant Agent, Lawrence Gas Company, 370 Essex Street, Lawrence, Massachusetts.

Sawyer, F. H., October, 1906.
General Manager, New Bern Gas Company, New Bern, North Carolina.

Schaaf, August Henry, March, 1914. (N) (P)
Photometric Inspector, Brooklyn Union Gas Company, 130 Atlantic Avenue, Brooklyn, New York.

Schaddelee, Richard, October, 1906. (P)
Vice-President, United Light & Railway Company, 411 Michigan Trust Building, Grand Rapids, Michigan.

Schauer, Frank F., October, 1906.
Assistant Engineer, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

Schenck, Rudolph, October, 1906.
Assistant Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Scherck, Leon H., October, 1906. (P)
Sales Manager, Central Hudson Gas & Electric Company, 50 Market Street, Poughkeepsie, New York.

Schick, Karl August, March, 1911.
Assistant Superintendent, Commercial Department, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

Schiller, Charles C., October, 1906.
Superintendent of Meters, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

Schindler, Morris Daniel, September, 1912.
Manager, Gas Light Company of Augusta, Augusta, Georgia.

Schlesinger, Ferdinand, March, 1914. (N)
President, Milwaukee Coke & Gas Company, Colby-Abbott Building, Milwaukee, Wisconsin.

Schmidt, Edgar Henry, September, 1914. (N)
Fitting Shop Superintendent, Northern Union Gas Company, 1815 Webster Avenue, New York, New York.

Schmidt, Emil G., October, 1906.
President, Des Moines City Railway Company, Des Moines, Iowa.

Schmidt, F. W., October, 1906. (P)
Division Agent, Public Service Gas Company, 84 Sip Avenue, Jersey City, New Jersey.

Schneider, Philip J., March, 1911. (P)
Treasurer, Central Union Gas Company, 519 Courtlandt Avenue, New York, New York.

Schobel, Frederick A., March, 1911. (P)
Superintendent of Distribution, Municipal Gas Company, 1131 Broadway, Albany, New York.

Schroeder, Albert George, September, 1912.
Purchasing Agent, Grand Rapids Gas Light Company, Ottawa and Pearl Streets, Grand Rapids, Michigan.

Schutt, Harry S., October, 1906. (P)
General Manager, C. H. Geist Company, 1127 Land Title Building, Philadelphia, Pennsylvania.

Schwabe, Walter P., March, 1911. (P)
General Manager, Northern Connecticut Light & Power Company, 15 Central Street, Thompsonville, Connecticut.

Schwarm, C. A., October, 1906.
General Superintendent, Henry M. Wallace Company, 705 Union Trust Building, Detroit, Michigan.

Scobell, E. C., October, 1906.
Assistant Auditor, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

Scofield, Thomas, September, 1910. (P)
Illuminating Engineer, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Scott, Alexander H., September, 1908.
Engineer, Peoples Gas Light Company, 39 Hanover Street, Manchester, New Hampshire.

Scott, John Joseph, September, 1912. (P)
Superintendent, Lewiston Gas Light Company, 88 Shawmut Street, Lewiston, Maine.

Scott, John M., September, 1908.
Secretary and Treasurer, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

Scott, Rossiter Stockton, March, 1908. (P)
Assistant Engineer, Consolidated Gas, Electric Light & Power Company, Baltimore, Maryland.

Scranton, George H., October, 1906.
Secretary, Derby Gas Company, 22 Elizabeth Street, Derby, Connecticut.

Scranton, Worthington, October, 1906.
Vice-President, Hyde Park Gas Company, 115 Wyoming Avenue, Scranton, Pennsylvania.

Seamon, J. Fred, October, 1906.
Engineer of Manufacture and Construction, 165 Hayward Street, Brooklyn, New York.

Searle, Robert M., October, 1906. (P)
Vice-President, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

Secord, Warren L., October, 1906. (P)
General Superintendent of Meters, Westchester Lighting Company, First Avenue and First Street, Mt. Vernon, New York.

Seddon, Samuel Venable, September, 1913. (P)
Superintendent, Metropolitan Works, Brooklyn Union Gas Company, 12th Street and Gowanus Canal, Brooklyn, New York.

Serrill, William J., October, 1906.
Engineer of Distribution, Philadelphia Gas Works, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Seymour, Fredk. Warner, September, 1912. (P)
Superintendent of Manufacture, Grand Rapids Gas Light Company, Grand Rapids, Michigan.

Seymour, William W., October, 1906.
President, Gray's Harbor Gas Company of Aberdeen, Washington, 324 Tacoma Building, Tacoma, Washington.

Shacklette, R., October, 1906.
Secretary and General Manager, Big Rapids Gas Company, Big Rapids, Michigan.

Shaeffer, John Wallace, March, 1911.
Superintendent, The Milwaukee Coke & Gas Company, 187 Greenfield Avenue, Milwaukee, Wisconsin.

Shaffner, Samuel C., March, 1907.
Middle West Utilities Company, 6105 Kimbark Avenue, Chicago, Illinois.

Shattuck, A. F., October, 1906. (P)
Chief Chemist, The Solvay Process Company, Solvay and Jefferson Avenues, West, Detroit, Michigan.

Shattuck, John D., October, 1906. (P)
General Manager, Philadelphia Gas & Electric Company, 6th and Welsh Streets, Chester, Pennsylvania.

Shaul, Clifford Dale, September, 1914. (N)
General Manager, Citizens Gas & Fuel Company, 636 Wabash Avenue, Terre Haute, Indiana.

Shaw, H. S., October, 1906.
Treasurer and Superintendent, Webster Electric Company, Webster, Massachusetts.

Shaw, John Cargill, September, 1913. (P)
Assistant Superintendent, Mechanical Department, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

Shepard, David James, March, 1911.
Engineer, 205 Hooper Street, Brooklyn, New York.

Shepard, Frederick C., October, 1906.
Superintendent, Minneapolis Gas Light Company, 16 Seventh Street, Minneapolis, Minnesota.

Shepard, Richard, September, 1912. (P)
Superintendent of Pavements and General Storekeeper, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Sherwood, E. J., October, 1906.
Manager, Mitchell Power Company, Mitchell, South Dakota.

Sherwood, M. S., September, 1907. (P)
Agent, Gas Department, Public Service Gas Company, 446 Springfield Avenue, Summit, New Jersey.

Shiebler, Marvin, September, 1908. (P)
Gas Engineer, 30 Church Street, New York, New York.

Shields, Henry C., March, 1913.
Vice-President and General Manager, Troy Gas Company, Troy, New York.

Shimomura, Kotaro, September, 1914. (N)
Chief Engineer, Osaka Gas Company, Osaka, Japan.

Silverthorn, James C., March, 1911.
Gas and Electric Light Company, Evansville, Indiana.

Simons, Keating Lewis, September, 1907.
Vice-President and General Manager, El Paso Gas and Electric Company, El Paso, Texas.

Simpson, Colin C., March, 1911. (P)
Assistant General Superintendent of Mains and Services, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Simpson, Henry, March, 1911. (P)
Superintendent, Consolidated Gas Company, 112 West 42d Street, New York, New York.

Singer, Sidney Charles, March, 1908.
Superintendent of Distribution, Syracuse Lighting Company, 736 South Beech Street, Syracuse, New York.

Sinsel, Otis A., October, 1906.
Assistant Engineer, Detroit City Gas Company, 57 Webb Avenue, Detroit, Michigan.

Sissingh, Melchior Corstius, March, 1914. (N)
Manager, Municipal Gas Works, Rotterdam, "Gemeente-Gasbedryf," Oost-Zeedyk, Rotterdam.

Slade, Richmond E., October, 1906. (P)
Engineer, Providence Gas Company, 20 Central Square, Providence, Rhode Island.

Slater, Surrey W., March, 1914. (N) (P)
Superintendent's Assistant, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Sloan, J. C., October, 1906.
Manager, Port Huron Gas Company, Port Huron, Michigan.

Smith, A. J., October, 1906.
Superintendent, Concord Light & Power Company, 90 North Main Street, Concord, New Hampshire.

Smith, Elmer W., March, 1907.
Manager, Kewanee Light & Power Company, Kewanee, Illinois.

Smith, Geo. P., Jr., September, 1910.
Superintendent, Old Colony Gas Company, Quincy Avenue, East Braintree, Massachusetts.

Smith, H. M., March, 1914. (N)
General Superintendent, Citizens Gas & Electric Company, 714 Bayard Street, Waterloo, Iowa.

Smith, J. Henderson, September, 1913.
Chief Clerk, General Auditor's Department, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Smith, Louis C., September, 1913.
Manager, Fulton County Gas & Electric Company, 18 East Fulton Street, Gloversville, New York.

Smith, Raymond H., March, 1909.
General Manager, Jackson Light & Traction Company, 720 Arlington Street, Jackson, Mississippi.

Smith, Shaler G., March, 1914. (N)
Engineer, Construction of Gas Works, Rockford Gas Light & Coke Company, Rockford, Illinois.

Snow, William H., October, 1906.
General Manager, New Bedford Gas & Edison Light Company, 693 Purchase Street, New Bedford, Massachusetts.

Snyder, Albert I., September, 1911.
President, Utilities Engineering Corporation, 1458 Robinson Road, Grand Rapids, Michigan.

Snyder, Charles S., March, 1907. (P)
Superintendent, West Philadelphia District, United Gas Improvement Company, 4650 Market Street, Philadelphia, Pennsylvania.

Snyder, Harry L., March, 1911.
Secretary and Treasurer, New York & Queens Electric Light & Power Company, 444 Jackson Avenue, Long Island City, New York.

Sombart, W. E., October, 1906.
Secretary and Treasurer, Sombart Gas Company, Boonville, Missouri.

Soult, George H., March, 1911.
Assistant District Superintendent, Public Service Gas Company, 175 Ridgewood Avenue, Ridgewood, New Jersey.

Spangenberg, Brewster H., October, 1906.
Toms River, New Jersey.

Speaker, George S., March, 1912.
Treasurer and General Manager, Lebanon Gas & Fuel Company, 17 North 8th Street, Lebanon, Pennsylvania.

Spear, M. H., October, 1906. (P)
Secretary and Manager, New York & Queens Gas Company, 88 Main Street, Flushing, New York.

Spencer, Elliott L., March, 1912. (P)
Engineer, Central Union Gas Company, 905 East 138th Street, New York, New York.

Sperling, Nath. Jos., September, 1909. (P)
Superintendent, Mechanical Department, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

Spitzglass, Jacob M., September, 1912. (P)
Mechanical Engineer, Peoples Gas Light & Coke Company, 1701 Peoples Gas Building, Chicago, Illinois.

Spragle, L. D., October, 1906.
General Manager, Berwick Gas Company, 102 Mulberry Street, Berwick, Pennsylvania.

Squier, Harold Newton, September, 1912. (P)
Superintendent, Hyde Park Gas Company, 115 Wyoming Avenue, Scranton, Pennsylvania.

Stacey, Frederick A., October, 1906.
President, Chillicothe Gas & Water Company, Chillicothe, Ohio.

Stack, Edward M., March, 1910. (P)
General Superintendent, Hyde Park Gas Company, 115 Wyoming Avenue, Scranton, Pennsylvania.

Staniford, Arthur Fowler, March, 1908. (P)
Vice-President, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Stannard, Clare N., October, 1906.
Secretary and Commercial Manager, Denver Gas & Electric Company, 900 15th Street, Denver, Colorado.

Stark, Arthur William, March, 1913. (P)
Engineer's Assistant, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Stealey, Lee G., March, 1912.
Manager, St. Charles Lighting Company, St. Charles, Missouri.

Steele, G. W., March, 1909.
Manager, Lehigh-Northampton Light, Heat & Power Company, 123 Bridge Street, Catasauqua, Pennsylvania.

STEINWEDELL, GEORGE, October, 1906.
Commercial Manager, St. Paul Gas Light Company, Sixth and Jackson Streets, St. Paul, Minnesota.

STEINWEDELL, W. E., October, 1906. (P)
Secretary, Gas Machinery Company, 1900 Euclid Avenue, Cleveland, Ohio.

STEVICK, CRIST H., October, 1906. (P)
Superintendent, Ravenswood Works, New Amsterdam Gas Company, 237 Grand Avenue, Astoria, Long Island, New York.

STEWART, SAMUEL B., October, 1906.
General Contracting Agent, Philadelphia Company, and Consolidated Gas Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

STILES, GEORGE WARREN, September, 1912. (P)
Superintendent, Fitchburg Gas & Electric Light Company, Fitchburg, Massachusetts.

STILES, HARRY B., October, 1906.
Purchasing Agent, St. Paul Gas Light Company, Sixth and Jackson Streets, St. Paul, Minnesota.

STILES, LINFORD SPEARING, March, 1910. (P)
Construction Engineer, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

STILLSON, HOWARD G., October, 1906.
Superintendent, Boone Gas Company, Boone, Iowa.

STILWELL, JOHN, September, 1909. (P)
Engineer, Department of Meters, Consolidated Gas Company, 130 East 15th Street, New York, New York.

STIRZEL, JACOB W., October, 1906. (P)
Superintendent of Holder Stations and Pumping Mains, Philadelphia Gas Works, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

ST. JOHN, JOHN, September, 1909.
Secretary and Treasurer, Madison Gas & Electric Company, 120 East Main Street, Madison, Wisconsin.

STONE, C. H., March, 1911. (P)
Manager, Gas Department, Orange County Lighting Company, 12 South Street, Middletown, New York.

STONE, FREDERICK W., October, 1906.
Manager, The Ashtabula Gas Company, Ashtabula, Ohio.

STRANGE, HARRY LATIMER, March, 1911.
Manager, Honolulu Gas Company, Ltd., Post Office Box 1379, Honolulu, Oahu, Hawaii.

STRECKER, ALEXANDER H., October, 1906. (P)
Consulting Engineer, Public Service Gas Company, 235 Mt. Pleasant Avenue, Newark, New Jersey.

STRING, JOSEPH S., September, 1914. (N) (P)
Manager, Brockton Gas Light Company, 46 Centre Street, Brockton, Massachusetts.

STROHN, C. B., October, 1906.
District Manager, Western United Gas & Electric Company, Elgin, Illinois.

STROHN, R. N., October, 1906.
Vice-President and Treasurer, Western United Gas & Electric Company, Aurora, Illinois.

STROUD, MORRIS W., October, 1906.
President, The American Gas Company, West Washington Square, Philadelphia, Pennsylvania.

STULL, C. RODMAN, March, 1909.
Resident Manager, Waukesha-American Gas Co., Waukesha, Wisconsin.

SUCHER, THEODORE RICHARD, September, 1914. (N)
Superintendent of Mains and Services, New Haven Gas Light Company, 80 Crown Street, New Haven, Connecticut.

SUCHOMEL, THOMAS, October, 1906.
Superintendent of Gas Works, Cedar Rapids Gas Light Company, 501 6th Avenue, Cedar Rapids, Iowa.

SULLIVAN, BEVERLY NATHANIEL, March, 1908.
Manager, Winston-Salem Light & Fuel Company, Winston-Salem, North Carolina.

SUMMERS, GEORGE, October, 1906.
Chief Engineer, Citizens Gas Company, 645 East 21st Street, Indianapolis, Indiana.

SUMNER, ARTHUR WILLIAM, March, 1913.
Gas Engineer and Manager, Grays & Tilbury Gas Company, Bank Building, Grays, Essex, England.

SWAN, GEO. J., September, 1907.
Superintendent, Consumers Light, Heat & Power Company, 214 East First Street, Topeka, Kansas.

SWANN, HARRY R., October, 1906.
Chief Inspector (*ex-Officio*), Louisville Gas & Electric Company, 654 South Floyd Street, Louisville, Kentucky.

SWEETMAN, M. M., October, 1906.
General Superintendent, Kansas Natural Gas Company, 3410 Baltimore Avenue, Kansas City, Missouri.

SWEETMAN, W. D., October, 1906.
Superintendent, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

TAIT, FRANK M., October, 1906.
President, The Dayton Power & Light Company, 124 East Fourth Street, Dayton, Ohio.

TALBOTT, FRANK, October, 1906. (P)
Superintendent and Treasurer, City of Danville Water & Light Department, Main Street, Danville, Virginia.

TAUSSIG, J. HAWLEY, October, 1906. (P)
Engineer of Design, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

TAYLOR, ALLYN CHANDLER, September, 1908.
Engineering Assistant, Allentown Gas Company, 516 Hamilton Street, Allentown, Pennsylvania.

TAYLOR, HORACE GREELEY, March, 1914.
Assistant Engineer to Agent, Lawrence Gas Company, 370 Essex Street, Lawrence, Massachusetts.

TAYLOR, JOHN BYRON, September, 1907.
Treasurer, Watertown Gas Light Company, Watertown, New York.

TAYLOR, WM. H., September, 1908. (P)
Manager, Omaha Gas Company, 1509 Howard Street, Omaha, Nebraska.

TENNEY, ALBERT BALL, September, 1907. (P)
Vice-President, Malden Electric Company, Malden & Melrose Gas Light Company, 201 Devonshire Street, Boston, Massachusetts.

TENNEY, CHARLES H., October, 1906. (P)
President, Springfield Gas Company, Springfield, Massachusetts.

TERRY, H. WARREN, JR., October, 1906. (P)
Superintendent, Northern Westchester Lighting Company, 127 Main Street, Ossining, New York.

THOMAS, CARL C., March, 1912.
Professor of Mechanical Engineering, Johns Hopkins University, 114 Roland Avenue, Baltimore, Maryland.

THOMAS, CHARLES G. M., October, 1906. (P)
President, New York & Queens Electric Light & Power Company, 444 Jackson Avenue, Long Island City, New York.

THOMAS, NATHANIEL W., September, 1912.
Chief Inspector, Bureau of Gas, 1513 Centennial Avenue, Philadelphia, Pennsylvania.

THOMPSON, CLARENCE E., September, 1912.
President, Wallingford Gas Light Company, 810 Chapel Street, New Haven, Connecticut.

THOMPSON, PAUL, October, 1906.
Fifth Vice-President, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

THOMSON, GEORGE W., October, 1906. (P)
Assistant Manager, Philadelphia Suburban Gas & Electric Company, 6th and Welsh Streets, Chester, Pennsylvania.

THOMSON, W. H., JR., September, 1908.
General Manager, Des Moines Electric Company, 8th and Locust Streets, Des Moines, Iowa.

THORN, FREDK. GODFREY, JR., October, 1906. (P)
Engineer of Construction, Philadelphia Gas Works, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

THUMAN, FREDERIC, September, 1907.
Chief Engineer and General Manager, Humphreys & Glasgow, 38 Victoria Street, London, S. W., England.

THWING, ORRELL O., October, 1906. (P)
Chief Engineer, Western Gas Construction Company, 3002 Thompson Avenue, Fort Wayne, Indiana.

TINCHER, T. SYMMES, September, 1911.
Superintendent of Manufacture, Washington Gas Light Company, 3918 New Hampshire Avenue, N. W., Washington, District of Columbia.

TIPPY, B. O., October, 1906.
Consulting Engineer, 710 Union Trust Building, Detroit, Michigan.

TIPPY, CHARLES W., October, 1906.
General Manager, Commonwealth Power Company, 214 West Main Street, Jackson, Michigan.

TITZEL, R. JOHN, September, 1911.
Gas Engineer, American Cities Company, 201 Baronne Street, New Orleans, Louisiana.

TOBEY, FRANKLIN, JR., October, 1906. (P)
Manager, Kingston Gas & Electric Company, 611 Broadway, Kingston, New York.

TOLMAN, WILLIAM N., October, 1906. (P)
Constructing Engineer, Counties Gas & Electric Company, Norristown, Pennsylvania.

Townsend, Alfred Freeman, September, 1913.
Manager, Blackstone Valley Gas & Electric Company, 3 Clinton Street, Woonsocket, Rhode Island.

Traver, Alva F., October, 1906.
Superintendent, Gas Department, Gas & Electric Company, 900 15th Street, Denver, Colorado.

Travis, Frank M., October, 1906.
Secretary, Winsted Gas Company; Treasurer, Torrington Electric Light & Gas Company, 58 Church Street, Torrington, Connecticut.

Treadway, Alfred Alanson, September, 1914. (N) (P)
Superintendent of Shop Department, Detroit City Gas Company, 146 Glynn Court, Detroit, Michigan.

Treleaven, L. G., September, 1907.
Receiver, Consumers Light, Heat & Power Company, 824 Kansas Avenue, Topeka, Kansas.

Trimble, James, September, 1914. (N)
Vice-President and Manager, Sault Ste. Marie Gas & Electric Company, 419 Ashmun Street, Sault Ste. Marie, Michigan.

Tucker, C. A., October, 1906.
Assistant Treasurer, Rochester Railway & Light Company, 34 Clinton Avenue, North, Rochester, New York.

Tudbury, John Leslie, September, 1914. (N) (P)
Manager, Salem Gas Light Company, 247 Essex Street, Salem, Massachusetts.

Tull, Lucien P. F., October, 1906. (P)
Accountant, New Amsterdam Gas Company, 130 East 15th Street, New York, New York.

Turner, Alfred E., September, 1912. (P)
Assistant General Superintendent of Meters, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Turney, Henry D., October, 1906.
President, The Columbus Gas & Fuel Company, 135 North Front Street, Columbus, Ohio.

Tuttle, W. B., October, 1906.
Vice-President and General Manager, San Antonio Gas & Electric Company, 305 East Houston Street, San Antonio, Texas.

Tutwiler, Carrington Cabell, October, 1906. (P)
Consulting Chemist, 1630 Real Estate Trust Building, Philadelphia, Pennsylvania.

Uhlig, Edward C., March, 1911. (P)
Chief Chemist, Brooklyn Union Gas Company, 5th and Hoyt Streets, Brooklyn, New York.

Underhill, Henry L., September, 1908. (P)
Assistant Engineer of Manufacture, Consolidated Gas Company of New York, Residence, 241 West 108th Street, New York, New York.

Underwood, Charles E., March, 1914. (N)
Superintendent, Coke Plant, Coal Products Manufacturing Company, Joliet, Illinois.

Vance, Champ Shepherd, September, 1910.
Third Vice-President, Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, California.

Van den Driessche, Achilles, September, 1910. (P)
Assistant Engineer, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Van Ness, L. G., October, 1906.
Secretary, The Merchants Power Company, 48 North Second Street, Memphis, Tennessee.

Vander Willigen, T. A., September, 1908.
Continental Representative of Humphreys & Glasgow, Ltd., 209 Chaussee D'Ixelles, Brussels, Belgium.

Vincent, G. I., October, 1906. (P)
Engineer, Des Moines Gas Company, 412 West 7th Street, Des Moines, Iowa.

vonMaur, Jacob D., October, 1906.
Superintendent of Distribution, Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

von Phul, William, September, 1912.
Member of firm Ford, Bacon & Davis, Engineers, 921 Canal Street, New Orleans, Louisiana.

von Starzenski, Victor, March, 1909. (P)
Superintendent, Mohawk Gas Company, 511 State Street, Schenectady, New York.

vonVittinghoff, Hans, September, 1908.
Secretary to Vice-President, Stone & Webster, 147 Milk Street, Boston, Massachusetts.

Voorhees, Andrew John, March, 1913.
Secretary to Vice-President, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

WAGNER, FRED H., March, 1907. (P)
Chief Engineer, The Bartlett Hayward Company, Scott and McHenry Streets, Baltimore, Maryland.

WAINWRIGHT, ARTHUR V., October, 1906.
General Manager, American Public Service Company, Abilene, Texas.

WALDRON, CHARLES, JR., September, 1908.
Manager, Philadelphia Suburban Gas & Electric Company, Phoenixville, Pa.

WALKER, EDWIN M., October, 1906.
General Manager, Union Electric Company, Dubuque, Iowa.

WALKER, M. T., October, 1906.
Manager, Beaumont Gas Light Company, Beaumont, Texas.

WALLACE, R. A., October, 1906.
Superintendent, Gas Division, Quebec Railway, Light, Heat & Power Company, 10 Palace Hill, Quebec, Canada.

WALLACE, ROSS STRAWN, March, 1913.
Second Vice-President and General Manager, Central Illinois Light Company, 316 South Jefferson Avenue, Peoria, Illinois.

WALLACE, SCOTT HENRY, September, 1912.
Assistant General Manager, St. Louis County Gas Company, Lockwood and McClure Avenues, Webster Groves, Missouri.

WALTER, E. P., September, 1913.
Engineer, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

WALTERS, BENJ. S., October, 1906.
Manager, Northern Indiana Gas & Electric Company, 215 South Michigan Street, South Bend, Indiana.

WARING, CLARENCE H., March, 1914. (N) (P)
Superintendent, Wyandotte County Gas Company, 600 Minnesota Avenue, Kansas City, Kansas.

WARING, GEORGE H., October, 1906. (P)
Vice-President and General Manager, Charleston Consolidated Railway & Lighting Company, 141 Meeting Street, Charleston, South Carolina.

WARMINGTON, DANIEL R., October, 1906.
1804 East 63d Street, Cleveland, Ohio.

WARNER, GEORGE H., October, 1906. (P)
Vice-President, William M. Crane Company, 16 West 32d Street, New York, New York.

WARNICK, JOHN H., September, 1908. (P)
Assistant to General Superintendent, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

WATERBURY, HERBERT JESSUP, September, 1910.
Manager, Marquette Gas Light Company, Marquette, Michigan.

WATERS, JOHN A., October, 1906.
Assistant Superintendent, Gas Department, The Stamford Gas & Electric Company, 11 Bank Street, Stamford, Connecticut.

WAY, ALEXANDER B., September, 1911. (P)
Chief Chemist, New England Gas & Coke Company, Everett, Massachusetts.

WEBBER, PAUL B., March, 1914. (N)
Treasurer, Athol Gas & Electric Company, 78 Devonshire Street, Boston, Massachusetts.

WEBER, F. C., September, 1910. (P)
Gas Engineer, H. L. Doherty & Company, 60 Wall Street, New York, New York.

WEBER, T. G., March, 1914. (N)
Engineer's Assistant, Central Union Gas Company, 905 East 138th Street, New York, New York.

WEBER, THEO. J., September, 1908.
Consulting Engineer, United Light & Railway Company, 823 Michigan Trust Building, Grand Rapids, Michigan.

WEHNER, ADOLPH FREDERICK, October, 1906.
Secretary, Isbell-Porter Company, 46 Bridge Street, Newark, New Jersey.

WEHNERT, H. C., September, 1913.
Superintendent, Station A, Laclede Gas Light Company, Laclede Gas Building, 11th and Olive Streets, St. Louis, Missouri.

WEINMEISTER, CARL J., March, 1914. (N)
Superintendent of Mains, Atlanta Gas Light Company, Electric and Gas Building, Atlanta, Georgia.

WEISGERBER, EDWIN C., October, 1906.
116 Seymour Avenue, Newark, New Jersey.

WELCH, JOHN S., October, 1906.
Manager, Industrial Division, The United Gas Improvement Company, 1035 Market Street, Philadelphia, Pennsylvania.

WELCH, WILLIAM MCNAIR, October, 1906.
Mechanical Engineer, Bureau of Mines Experimental Station, Custom House, San Francisco, California.

Welsh, William J., October, 1906. (P)
President and Manager, New York & Richmond Gas Company, 691 Bay Street, Stapleton, Staten Island, New York.

Wepfer, William Mackness, March, 1914. (N) (P)
Chief Draftsman, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Werner, Louis H., September, 1910. (P)
Secretary, Central Union Gas Company, 519 Courtlandt Avenue, New York, New York.

Westcott, John Townsend, October, 1906.
Consulting Engineer, 11 Strawberry Hill Road, Twickenham, London, England.

Weston, Edgar C., September, 1912. (P)
Superintendent, Gas Light Company, 240 Court Street, Middletown, Connecticut.

Wheeler, Fred B., October, 1906.
Gas Engineer, Stepney Depot, Connecticut.

Wheeler, H. A., September, 1907.
Agent, Gas and Electric Departments, Public Service Gas Company, 27 West 8th Street, Bayonne, New Jersey.

Whipple, Henry S., October, 1906. (P)
Manager, Rockford Gas Light & Coke Company, 201 Mulberry Street, Rockford, Illinois.

Whitcomb, H. D., October, 1906. (P)
General Manager, Public Service Gas Company, Room 608, Public Service Building, Newark, New Jersey.

White, Alfred H., September, 1909.
Professor of Chemical Engineering, University of Michigan, 715 Church Street, Ann Arbor, Michigan.

White, Henry H., October, 1906.
Care of Gas Company, Muskogee, Oklahoma.

White, John T., March, 1911. (P)
Superintendent of Street Main Department, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Whiteley, Benjamin, September, 1908.
Assistant Treasurer, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Whitney, Roy Foxwell, March, 1910.
Manager and Treasurer, Peoples Gas & Electric Company, 70 East First Street, Oswego, New York.

WHITTAKER, ALAN DEAN, October, 1910.
Superintendent of Works, Atlanta Gas Light Company, 38 Thurmond Street, Atlanta, Georgia.

WHITTON, W. H., October, 1906.
Secretary and Treasurer, Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

WHITWELL, L. M., March, 1909. (P)
General Superintendent, Semet-Solvay Company, Syracuse, New York.

WHITWELL, SANFORD N., September, 1912.
General Auditor, Washington Gas Light Company, 413 10th Street, N. W., Washington, District of Columbia.

WHYSALL, GEORGE, October, 1906.
Consulting Engineer, Hamilton (Ontario) Gas Light Company, Marion, Ohio.

WILDE, CHARLES, March, 1908. (P)
Engineer of Mains, Philadelphia Suburban Gas & Electric Company, 6th and Welsh Streets, Chester, Pennsylvania.

WILDER, STUART, September, 1912. (P)
Vice-President and General Manager, Northern Westchester Lighting Company, First Avenue and First Street, Mt. Vernon, New York.

WILEY, LYMAN A., March, 1910.
Secretary, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

WILKE, ARNO C., March, 1909.
Chemist, Milwaukee Gas Light Company, 25th Street and St. Paul Avenue, Milwaukee, Wisconsin.

WILKINSON, A. L., October, 1906.
Treasurer, National Gas, Electric Light & Power Company, 1714 Ford Building, Detroit, Michigan.

WILLARD, FRED A., March, 1907.
Manager, McAlester Gas & Coke Company, McAlester, Oklahoma.

WILLIAMS, E. H., October, 1906.
Manager, The Waterbury Gas Light Company, Waterbury, Connecticut.

WILLIAMS, HERBERT G., October, 1906.
Manager, Luzerne County Gas Company, 247 Wyoming Avenue, Kingston, Pennsylvania.

WILLIAMS, LUTHER S., October, 1906. (P)
Manager, Harrisburg Gas Company, Harrisburg, Pennsylvania.

WILLIAMS, WILLIAM L., October, 1906.
Engineer (Retired), Public Service Gas Company, 63 Twelfth Avenue, Paterson, New Jersey.

WILLIAMSON, JOHN, October, 1906.
Vice-President and Consulting Engineer, Peoples Gas Light & Coke Company, 122 South Michigan Avenue, Chicago, Illinois.

WILLIS, CHARLES MOORE, March, 1907.
Superintendent, Hartford City Gas Light Company, 565 Main Street, Hartford, Connecticut.

WILLS, JOHN VALENTINE, September, 1911.
Superintendent of Gas Works, Indiana Lighting Company, 1011 Old Fort Street, Fort Wayne, Indiana.

WILSON, G. J., October, 1906.
Fort Tryon Hall, 196th Street and Fort Washington Avenue, New York, New York.

WILSON, H. H., March, 1907.
Manager, Wausau Gas Company, 401 Fourth Street, Wausau, Wisconsin.

WILSON, RODNEY M., September, 1912. (P)
Chief Draughtsman, Department of Mains and Services, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

WILSON, W. A., October, 1906.
Superintendent, Rockford Gas Light & Coke Company, Rockford, Illinois.

WING, JOHN FRANKLIN, March, 1908. (P)
Superintendent, Everett Station, Boston Consolidated Gas Company, Everett, Massachusetts.

WITHERBY, EDWIN C., October, 1906. (P)
General Superintendent, Semet-Solvay Company, Syracuse, New York.

WITHERBY, EDWIN E., October, 1906. (P)
New England Representative, Gas Machinery Company, Boston, Massachusetts, East Harpswell, Maine.

WOLFF, SAMUEL E., October, 1906.
Care of Hodenpyl, Hardy & Company, 14 Wall Street, New York, New York.

WOOD, WILLIAM AUSTIN, October, 1906. (P)
First Vice-President and Engineer-in-Chief, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

Wood, William Musgrave, September, 1907.
Department of Second Vice-President, The United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Woodall, George Herbert, September, 1908. (P)
General Manager and Engineer, Brooklyn Borough Gas Company, Surf Avenue and West 12th Street, Coney Island, New York.

Woods, George E., October, 1906. (P)
Assistant Chief Engineer, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Wortendyke, I. F., October, 1906.
Superintendent, New Gas Light Company, 7 North Main Street, Janesville, Wisconsin.

Worthing, Leigh E., September, 1911.
Chief Chemist, Detroit City Gas Company, Gas Office Building, Detroit, Michigan.

Wright, W. H., October, 1906.
Engineer, Citizens Gas Company of Indianapolis, 2734 North Pennsylvania Street, Indianapolis, Indiana.

Wrightington, Edgar N., October, 1906. (P)
Secretary and Manager, Commercial Department, Boston Consolidated Gas Company, 24 West Street, Boston, Massachusetts.

Wuest, Henry Andrew, September, 1908. (P)
Chief Clerk, Brooklyn Union Gas Company, Foot North 12th Street, Brooklyn, New York.

Wyant, Robert E., October, 1906. (P)
Engineer, New Haven Gas Light Company, 80 Crown Street, New Haven, Connecticut.

Wyman, Walter S., September, 1912.
Treasurer and General Manager, Central Maine Power Company, 311 Water Street, Augusta, Maine.

Young, Alfred W., October, 1906.
General Manager, Knoxville Gas Company, Knoxville, Tennessee.

Young, John T., March, 1907. (P)
General Manager, Grand Rapids Gas Light Company, Grand Rapids, Michigan.

Young, Percy S., October, 1906. (P)
Comptroller, Public Service Gas Company, 763 Broad Street, Newark, New Jersey.

Young, Peter, October, 1906. (P)
Gas Department, Watertown Light & Power Company, 135 Flower Street, Watertown, New York.

YOUNG, R. R., October, 1906. (P)
New Business Agent, Public Service Gas Company, Broad and Bank Streets, Newark, New Jersey.

YOUNG, ROBERT W. H., March, 1911. (P)
Superintendent, Consolidated Gas Company, 3300 Second Avenue, Pittsburgh, Pennsylvania.

ZEEK, CHARLES F., October, 1906.
Superintendent, Pensacola Gas Company, 27 East Garden Street, Pensacola, Florida.

Total Active Members.....1,128

ASSOCIATE MEMBERS.

AHLBRANDT, G. F., March, 1913.
Metallurgical Engineer, American Rolling Mill Company, Middletown, Ohio.

AIKIN, HUGH CARLTON, October, 1906. (P)
Eastern Sales Manager, Eclipse Gas Stove Company, 1016 Madison Street, Chester, Pennsylvania.

ANNETT, EDWARD BURDETT, September, 1911. (P)
Inspector of Gas, Public Utility Commission, State of New Jersey, 790 Broad Street, Newark, New Jersey.

ASENDORF, CARL F., October, 1906.
Representative, American Meter Company, 38 South Jefferson Street, Chicago, Illinois.

ATWATER, C. G., October, 1906. (P)
Engineer, American Coal Products Company, 17 Battery Place, New York, New York.

AZOY, ANASTASIO C. M., October, 1906. (P)
Manager, Berwind-White Coal Mining Company, 1 Broadway, New York, New York.

BALDWIN, ABRAM T., September, 1912. (P)
President and General Manager, Precision Instrument Company, 102 Randolph Street, Detroit, Michigan.

BALZ, GEORGE ADAM, March, 1911. (P)
Manager, Didier-March Company, Gas Engineers, Perth Amboy, New Jersey.

BARBOUR, WILLIAM TEFFT, October, 1906.
President, Detroit Stove Works, 1320 Jefferson Avenue, Detroit, Michigan.

Barnes, William Wallace, March, 1914. (N) (P)
Manufacturer, Bayley & Sons, Inc., 101 Park Avenue, New York, New York.

Behringer, Edward A., October, 1906. (P)
94 Warren Street, New York, New York.

Berry, F. K., October, 1906.
President, A. B. Stove Company, Battle Creek, Michigan.

Bettle, William H., March, 1908.
Superintendent, Appliance Department, Century Stove & Manufacturing Company, 629 Oregon Street, Santa Monica, California.

Bigelow, Lucius Seymour, October, 1906.
Editor, *The Gas Industry,* 64 Pearl Street, Buffalo, New York.

Bingham, R. W., October, 1906.
Contract Agent, Welsbach Street Lighting Company of America, Peoples Gas Building, Chicago, Illinois.

Blinks, Walter M., October, 1906.
Assistant Manager, General Gas Light Company, Park and Water Streets, Kalamazoo, Michigan.

Boothe, George P., October, 1906.
Superintendent, S. R. Dresser Manufacturing Company, Boylston Street, Bradford, Pennsylvania.

Braun, Charles A., March, 1914. (N)
Sales Agent, Stonega Coke & Coal Company, 629 Real Estate Trust Building, Philadelphia, Pennsylvania.

Brill, Alfred P., October, 1906.
General Manager, Ruud Manufacturing Company, 29th and Smallman Streets, Pittsburgh, Pennsylvania.

Brown, William Laird, September, 1912. (P)
Assistant Manager, Helme & McIlhenny, 1339 Cherry Street, Philadelphia, Pennsylvania.

Buell, Wm. C., Jr., September, 1909.
Secretary and General Manager, Westmacott Gas Furnace Company, 9 Codding Street, Providence, Rhode Island.

Bunnell, Sterling H., October, 1906. (P)
Engineer-in-Chief, Griscom-Russell Company, 90 West Street, New York, New York.

Caldwell, Jas. Henry, September, 1909.
President, Ludlow Valve Company, Troy, New York.

Carlisle, Edgar G., September, 1914. (N) (P)
Secretary, Blair Parke Coal & Coke Company, 1618 Real Estate Trust Building, Philadelphia, Pennsylvania.

Carpenter, Frank, March, 1911. (P)
Special Representative, Welsbach Gas Lamp Company, 392 Canal Street, New York, New York.

Carpenter, H. A., October, 1906. (P)
Vice-President, Riter-Conley Manufacturing Company, 56 Water Street, Pittsburgh, Pennsylvania.

Cartwright, Henry R., October, 1906. (P)
Manager, Philadelphia Factory, American Meter Company, Arch and 22d Streets, Philadelphia, Pennsylvania.

Cavenagh, Frank, March, 1911. (P)
Pacific Coast Representative, Metric Metal Works of the American Meter Company, 768 Mission Street, San Francisco, California.

Chapin, Edwin S., March, 1908. (P)
Vice-President, Welsbach Gas Lamp Company, 392 Canal Street, New York, New York.

Cheesman, Frank P., October, 1906. (P)
Partner, Cheesman & Elliot, 100 William Street, New York, New York.

Chisholm, Charles T., October, 1906.
Traveling Representative, General Gas Light Company, Kalamazoo, Michigan.

Clader, William A., March, 1912.
Secretary, H. E. Greims Corporation, 2142 Woolworth Building, New York, New York.

Claiborne, Chas. H., March, 1909. (P)
General Sales Manager, Union Mining Company, Manufacturers Mount Savage Fire Brick, 1113 Fidelity Building, Baltimore, Maryland.

Clark, Charles J., March, 1911.
Vice-President, Hunter & Dickson Company, 245 Arch Street, Philadelphia, Pennsylvania.

Clark, Robert Keep, March, 1914. (N)
Assistant Manager, George M. Clark & Company Division, 179 North Michigan Avenue, Chicago, Illinois.

Conroy, James P., March, 1913. (P)
Manager, General Gas Light Company, 46 West Broadway, New York, New York.

Cooke, Horace G., September, 1913.
Sales Agent, Connersville Blower Company, 114 Liberty Street, New York, New York.

CORBUS, F. G., October, 1906. (P)
Superintendent, Retail Departments, Welsbach Company, Gloucester City, New Jersey.

CRESSLER, ALFRED M., October, 1906.
Treasurer, The Kerr Murray Company, Peoples Gas Building, Chicago, Illinois.

CRESSLER, GEORGE H., October, 1906.
Sales Manager, The Kerr Murray Company, Peoples Gas Building, Chicago, Illinois.

CRUSE, ARTHUR R., October, 1906. (P)
Manager, Cruse Engineering Company, 109 West Penn Street, Germantown, Philadelphia, Pennsylvania.

CURFMAN, FLOYD G., September, 1914. (N) (P)
Manager, Gas Engine Department, D. R. Russell Engineering & Development Company, 519 International Life Building, St. Louis, Missouri.

DALY, DAVID R., October, 1906. (P)
Vice-President and General Manager, J. H. Gautier & Company, Green and Essex Streets, Jersey City, New Jersey.

DANIELS, CLARENCE F., March, 1911.
Salesman, Detroit Stove Works, 2921 LaSalle Street, Chicago, Illinois

DEHART, J. S., JR., October, 1906. (P)
President, Isbell-Porter Company, 46 Bridge Street, Newark, New Jersey.

DICKEY, EDMUND S., October, 1906. (P)
Member of Charles H. Dickey & Company, Guilford Avenue and Saratoga Street, Baltimore, Maryland.

DOUGHERTY, CHARLES, September, 1910. (P)
Air Compressor and Pneumatic Tool Salesman, Ingersoll-Rand Company, 11 Broadway, New York, New York.

DREWSON, JOHN, March, 1914. (N)
Superintendent of By-Product Coke Ovens, Woodward Iron Company, Woodward, Alabama.

EARNSHAW, WARNER G., September, 1908.
General Sales Manager, Barnes & Tucker Company, 718 Harrison Building, Philadelphia, Pennsylvania.

EISENMAN, F. N., September, 1908.
District Sales Manager, Gulf Refining Company, 110 State Street, Boston, Massachusetts.

Elmer, Charles Bliss, September, 1913.
Vice-President and Treasurer, General Gas Appliance Company, 103 Park Avenue, New York, New York.

Esau, Ralph, October, 1906.
Manager of Sales, Barrett Manufacturing Company, 1200 Otis Building, Chicago, Illinois.

Fairchild, Samuel E., Jr., September, 1912. (P)
President, Cruse-Kemper Company, Ambler, Pennsylvania; 6910 West Wissahickon Avenue, Mt. Airy, Philadelphia, Pennsylvania.

Foersterling, Dr. H., September, 1909.
Second Vice-President, Roessler & Hasslacher Chemical Company, 357 High Street, Perth Amboy, New Jersey.

Fowler, J. Scott, October, 1906. (P)
Vice-President and Treasurer, Deily & Fowler Manufacturing Company, 39 Laurel Street, Philadelphia, Pennsylvania.

Frampton, R. C., March, 1907. (P)
President, Pittsburgh Water Heater Company, Pittsburgh, Pennsylvania.

Francisco, Ellsworth, September, 1913. (P)
Inspector of Gas and Gas Meters, City Hall Annex, Newark, New Jersey.

Fritz, H. C., March, 1909.
Manager, Schneider & Trenkamp Division, American Stove Company, Cleveland, Ohio.

Garrison, John J., October, 1906.
Vice-President, Rathbone, Sard & Company, North Ferry Street, Albany, New York.

Goodman, Patrick, October, 1906.
Manager, Safety Gas Main Stopper Company, 257 East 133d Street, New York, New York.

Gribbel, W. Griffin, September, 1912. (P)
Assistant Manager, J. J. Griffin & Company, 1513 Race Street, Philadelphia, Pennsylvania.

Guitteau, William Standart, September, 1914. (N) (P)
Sales Manager, Lloyd Construction Company, 860 Greenwood Avenue, Detroit, Michigan.

Hamerstrom, Frederick Nathan, March, 1911. (P)
Commercial Department, Welsbach Company, Ellis and Mercer Streets, Gloucester, New Jersey.

Harper, H. D., October, 1906. (P)
Western Manager, American Meter Company, 1811 Peoples Gas Building, Chicago, Illinois.

Hatton, Richard D., March, 1914. (N)
Treasurer, D. R. Russell Engineering and Development Company, 519 International Life Building, St. Louis, Missouri.

Hayward, E. Bartlett, March, 1907. (P)
President, The Bartlett Hayward Company, Scott and McHenry Streets, Baltimore, Maryland.

Hayward, Sterling F., October, 1906. (P)
Treasurer, Connelly Iron Sponge & Governor Company (8 Dana Street, Cambridge, Massachusetts), 127 Duane Street, New York, New York.

Henry, William G., October, 1906.
Vice-President, Detroit Stove Works, Detroit, Michigan.

Herbert, Frederick D., September, 1911.
General Sales Manager, Terry Steam Turbine Company, 90 West Street, New York, New York.

Hicks, George Cleveland, Jr., October, 1906.
Vice-President and Mechanical Engineer, P. H. & F. M. Roots Company, Box 165, Connersville, Indiana.

Higgins, C. M., October, 1906.
Representative, The Standard Oil Company, 26 Broadway, New York, New York.

Hinman, Walter Hibbard, March, 1911. (P)
Representative, American Meter Company, 11th Avenue and 47th Street, New York, New York.

Hobdell, George, October, 1906.
Manager, Phoenix Meter Company, 107 Arch Street, Camden, New Jersey.

Hohmann, August B., September, 1911. (P)
Sales Manager, C. J. Tagliabue Manufacturing Company, Bush Terminal, 32 33d Street, Brooklyn, New York.

Hornsey, John W., September, 1910.
Consulting Engineer, Searles, California.

Hubbs, John Henry, September, 1908.
Assistant Purchasing Agent, The United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Hults, Eugene Arthur, March, 1913.
Sales Agent, General Electric Company, 1005 Monadnock Block, Chicago, Illinois.

Hutchinson, William P., March, 1912. (P)
Vice-President and Sales Manager, Sprague Meter Company, 205 Water Street, Bridgeport, Connecticut.

Hyde, Edward P., March, 1910.
Director, Physical Laboratory, National Electric Lamp Association, General Electric Company, Post Office Box 387, Nela Park, Cleveland, Ohio.

Isbell, Charles W., October, 1906.
President, Board of Directors, Isbell-Porter Company, 257 Broadway, New York, New York.

Jewett, Edward Huntting, September, 1914. (N)
President, Jewett, Bigelow & Brooks, 1109 Penobscot Building, Detroit, Michigan.

Johnston, E. D., October, 1906. (P)
President, P. H. & F. M. Roots Company, Connersville, Indiana.

Kahn, Julius, March, 1907.
General Manager, United Metal Hose Company, 510 West 24th Street, New York, New York.

Kahn, Lazard, October, 1906.
Vice-President, Estate Stove Company, Hamilton, Ohio.

Kane, William, October, 1906. (P)
President, William Kane Manufacturing Company, 1909 Adams Street, Philadelphia, Pennsylvania.

Kellum, Benjamin J., October, 1906.
Manager, Western Department, Welsbach Company, 141 North Wabash Avenue, Chicago, Illinois.

Kirchberger, Moritz, September, 1909.
President, Crescent Burner Company, 374 Second Avenue, New York, New York.

Knight, William H., October, 1906.
General Manager, Cleveland Gas Meter Company, 2180 East 65th Street, S. E., Cleveland, Ohio.

Koppers, Henry, October, 1907.
President, H. Koppers Company, Constructors of By-Products and Gas Ovens, 5 South Wabash Avenue, Chicago, Illinois.

Lanphier, Charles H., September, 1914. (N)
Gas and Meter Inspector, City of Springfield, Illinois, City Hall, Springfield, Illinois.

Lathrop, F. A., March, 1914. (N) (P)
Sales Agent (Chicago Office), Youngstown (Ohio) Sheet & Tube Company, 1563 McCormick Building, Chicago, Illinois.

Lauber, Albert, October, 1906.
Treasurer, Standard Meter & Manufacturing Company, 433 West 42d Street, New York, New York.

LEAKEY, NATHAN G., October, 1906.
Assistant Secretary, Michigan Ammonia Works, Detroit, Michigan.

LÉMOINE, LOUIS R., September, 1913.
President, United States Cast Iron Pipe & Foundry Company, 1421 Chestnut Street, Philadelphia, Pennsylvania.

LEWIS, THOMAS L., September, 1913.
Assistant Manager of Sales, A. M. Byers Company, 235 Water Street, Pittsburgh, Pennsylvania.

LITLE, THOMAS J., JR., October, 1906.
Engineer, Welsbach Company, Gloucester City, New Jersey.

LOCKWOOD, W. A., October, 1906.
General Salesman, Ringen Stove Company, 414 South Sixth Street, St. Louis, Missouri.

LUSH, JOSEPH, October, 1906. (P)
President, New York Improved Meter Company, 306 East 47th Street, New York, New York.

LYON, EDWARD A., September, 1908.
District Sales Manager, Gulf Refining Company, 814 Battery Park Building, New York, New York.

MCCLELLAN, JOHN W., September, 1908. (P)
Vice-President and General Manager, Manhattan Gas Heating Company, 909 Seventh Avenue, New York, New York.

MCCOY, WILLIAM P., March, 1911. (P)
Commercial Department, Welsbach Company, Gloucester, New Jersey.

MCDONALD, FREDERICK, September, 1909.
Gas Meter Manufacturer, 991 Broadway, Albany, New York.

MCILRAVY, W. N., October, 1906, (P)
Vice-President, Barrett Manufacturing Company, 17 Battery Place, New York, New York.

MCKEE, WILLIAM, March, 1914. (N) (P)
Secretary, Chaplin-Fulton Manufacturing Company, 34 Penn Avenue, Pittsburgh, Pennsylvania.

MCNARY, JOHN B., October, 1906.
Manager and Secretary, Canadian Meter Company, Limited, Hamilton, Ontario, Canada.

MACBETH, NORMAN, September, 1909. (P)
Illuminating Engineer; Editor, *Lighting Journal*; 241 West 37th Street, New York, New York.

MACKENZIE, KENNETH GERARD, March, 1914. (N)
Consulting Chemist, The Texas Company, Bayonne, New Jersey.

MANNING, W. E., March, 1914. (N)
Secretary, Youngstown Sheet & Tube Company, Youngstown, Ohio.

MARTINEAU, FREDERICK CLIFFORD, September, 1914. (N)
Field Engineer, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

MASON, JOHN AMBLER, September, 1909. (P)
With the Bartlett, Hayward Company, 100 Broadway, New York, New York.

MASON, SIDNEY, October, 1906. (P)
President, Welsbach Company, United Gas Improvement Company Building, Broad and Arch Streets, Philadelphia, Pennsylvania.

MELCHER, CHARLES W., October, 1906.
General Manager, Ingersoll-Rand Company of Illinois, Peoples Gas Building, Chicago, Illinois.

MILLAR, P. S., March, 1909. (P)
General Manager, New York Electrical Testing Laboratories, 80th Street and East End Avenue, New York, New York.

MILLER, EDWIN FRANCIS, September, 1914. (N)
Engineer, Camden Iron Works, Camden, New Jersey.

MILLER, FRED A., October, 1906. (P)
President and General Manager, S. R. Dresser Manufacturing Company, Boylston Street, Bradford, Pennsylvania.

MINGUS, JAMES B., March, 1910.
Sales Agent, Penn Gas Coal Company, 222 South Third Street, Philadelphia, Pennsylvania.

MORDUE, THOMAS N.
Coal Merchant, 817 Peoples Gas Building, Chicago, Illinois.

MORRELL, CLARENCE P., October, 1906. (P)
Wholesale Coal, Room 194, 1 Broadway, New York, New York.

MOUSER, OTIS, March, 1914. (N)
Sales Manager, Stonega Coke & Coal Company, Big Stone Gap, Virginia.

MUELLER, ROBERT, October, 1906. (P)
Secretary, H. Mueller Manufacturing Company, Decatur, Illinois.

NEWBOLD, E. S., March, 1909.
President, American Street Lighting Company, 831 Greenmount Avenue, Baltimore, Maryland.

Nicholls, Carroll B., October, 1906. (P)
Assistant Secretary, Westmoreland Coal Company, 224 South Third Street, Philadelphia, Pennsylvania.

Norton, Arthur E., October, 1906. (P)
Superintendent, Nathaniel Tufts Meter Company, 455 Commercial Street, Boston, Massachusetts.

Norton, Harry A., October, 1906. (P)
President and Manager, Nathaniel Tufts Meter Company, 455 Commercial Street, Boston, Massachusetts.

Nutty, G. R., October, 1906.
General Sales Manager, Gulf Refining Company, Frick Building Annex, Pittsburgh, Pennsylvania.

Osborne, Willard B., October, 1906. (P)
Managing Engineer, Lowell Gas Light Company, 46 Mansur Street, Lowell, Massachusetts.

Osius, George, October, 1906.
Secretary and Treasurer, Michigan Ammonia Works, Detroit, Michigan.

Page, Edward, September, 1908.
Secretary, New England Gas & Coke Company, 111 Devonshire Street, Boston, Massachusetts.

Papworth, Harry M., September, 1913.
Salesman and Eastern Manager, P. H. & F. M. Roots Company, 120 Liberty Street, New York, New York.

Parish, William H., March, 1913. (P)
Sales Engineer, Westmoreland Coal Company, 224 South 3rd Street, Philadelphia, Pennsylvania.

Parker, George W., October, 1906. (P)
Eastern Agent, Parker-Russell Mining & Manufacturing Company, 45 Broadway, New York, New York.

Parker, John F., September, 1910.
Western Sales Manager, Eclipse Gas Stove Company, Rockford, Illinois.

Patterson, Alfred R., September, 1912.
Auditor, Stone & Webster Management Association, 147 Milk Street, Boston, Massachusetts.

Pattison, Melvin, October, 1906. (P)
General Manager of Sales, Brown Hoisting Machinery Company, 4403 St. Clair Avenue, Cleveland, Ohio.

Payne, F. H., October, 1906. (P)
Manager, Metric Metal Works, 10th and Payne Streets, Erie, Pennsylvania.

Peck, Harry G., September, 1913. (P)
Treasurer, Gas Appliance Sales Company of America, 18 South 7th Street, Philadelphia, Pennsylvania.

Peffly, Irvin W., September, 1908.
Eastern Sales Manager, George M. Clark Company, Division American Stove Company, 1493 Broadway, New York, New York.

Penfield, H. P., March, 1914. (N)
Sales Manager, Ball Engine Company, 1001 Commercial Trust Building, Philadelphia, Pennsylvania.

Perkins, Rowan P., September, 1907. (P)
Consulting Engineer, Hale Building, Chestnut and Juniper Streets, Philadelphia, Pennsylvania.

Perry, A. T., October, 1906.
Vice-President, Barrett Manufacturing Company, 1317 Illuminating Building, Cleveland, Ohio.

Phillips, L. R., March, 1907.
Care of National Tube Company, Room 1114, 208 South LaSalle Street, Chicago, Illinois.

Pilz, C., March, 1907.
Secretary, New York Lead Wool Company, 93 Nassau Street, New York, New York.

Piser, Theo. H., October, 1906. (P)
Manager, Welsbach Company of New England, 16 Oliver Street, Boston, Massachusetts.

Plucker, Howard W., September, 1910.
Salesman, with I. A. Sheppard & Company, Erie Avenue and Sepviva Street, Philadelphia, Pennsylvania.

Porter, Roland G., October, 1906.
Chemist-Engineer, Riter-Conley Manufacturing Company, Pittsburgh, Pennsylvania.

Potter, Clifford C., March, 1910.
Manufacturer's Agent, Agent for Detroit Graphite Company, Room 702, 135 Broadway, New York, New York.

Prendergast, Daniel J., October, 1906. (P)
General Superintendent, Welsbach Street Lighting Company of America, 318 West 42d Street, New York, New York.

Price, W. W., October, 1906.
President, The Dayton Pipe Coupling Company, 435 East First Street, Dayton, Ohio.

RANCKE, LOUIS N., October, 1906.
Consulting Engineer and Chemist, 45 Knickerbocker Building, Baltimore, Maryland.

REEVES, WILLIAM, October, 1906.
President, The Reeves Manufacturing Company, Milford, Connecticut.

REICHHELM, PAUL F., September, 1908.
Secretary, American Gas Furnace Company, 24 John Street, New York, New York.

REINHARDT, G. A., March, 1914. (N) (P)
Metallurgist, Youngstown Sheet & Tube Company, Youngstown, Ohio.

REYNOLDS, M. G., October, 1906. (P)
General Manager, Reynolds Gas Regulator Company, 1019 Delaware Street, Anderson, Indiana.

RICHARDSON, CHARLES GERMANE, September, 1914. (N) (P)
Sales Engineer, Builders Iron Foundry, 135 Adelaide Avenue, Providence, Rhode Island.

ROBERTS, CLARENCE V., October, 1906. (P)
President, Roberts & Mander Stove Company, 11th Street and Washington Avenue, Philadelphia, Pennsylvania.

RODGERS, EDWARD H., October, 1906. (P)
President and Treasurer, Standard Meter Company, 3112 North 17th Street, Philadelphia, Pennsylvania.

ROESCH, DANIEL, October, 1906.
Assistant Professor of Experimental Engineering, Armour Institute of Technology, Armour Station, 33rd and Federal Streets, Chicago, Illinois.

ROLSTON, ROBERT J., March, 1911.
Manager, Welsbach Company, 1008 Filbert Street, Philadelphia, Pennsylvania.

RUST, ROBERT RIPLEY, March, 1910.
Superintendent of Foundries, Central Foundry Company, 90 West Street, New York, New York.

RUUD, EDWIN, September, 1907.
Manufacturer, Ruud Manufacturing Company, Pittsburgh, Pennsylvania.

SALT, THOMAS V., September, 1910.
37 Wall Street, New York, New York.

SANDERS, BARNEY H., September, 1912.
President and General Manager, American Foundry & Manufacturing Company, St. Louis, Missouri.

Sard, Russell E., September, 1909. (P)
Vice-President and General Manager, Rathbone, Sard & Company, Albany, New York.

Sayer, Eugene Y., October, 1906. (P)
Vice-President and General Manager, Improved Equipment Company, 60 Wall Street, New York, New York.

Schall, Henry D., October, 1906. (P)
Assistant to Vice-President, Detroit Stove Works, 1320 Jefferson Avenue, East, Detroit, Michigan.

Schurz, James R., September, 1907.
General Sales Agent, Camden Coke Company, 755 Broad Street, Newark, New Jersey.

Seaver, Kenneth, September, 1913. (P)
Chief Engineer, Harbison-Walker Refractories Company, Farmers Bank Building, Pittsburgh, Pennsylvania.

Seeger, Robert, October, 1906.
District Manager, Welsbach Street Lighting Company of America, 704 Laclede Gas Building, St. Louis, Missouri.

Shaw, Arthur E., September, 1914. (N)
President, Welsbach Street Lighting Company of America, 1934 Market Street, Philadelphia, Pennsylvania.

Sheppard, Howard R., September, 1909.
Member of firm of I. A. Sheppard & Company, 1801 North 4th Street, Philadelphia, Pennsylvania.

Smith, T. J., Jr., March, 1911.
Special Sales Representative, Pittsburgh Water Heater Company, Pittsburgh, Pennsylvania.

Speller, Frank N., March, 1907. (P)
Metallurgical Engineer, National Tube Company, Frick Building, Pittsburgh, Pennsylvania.

Sperry, Richard Evans, March, 1914. (N)
Superintendent of Construction, Bartlett Hayward Company, 100 Broadway, New York, New York.

Sprague, Henry H., March, 1908. (P)
President, Sprague Meter Company, 205 Water Street, Bridgeport, Connecticut.

Stacey, Andrew J., October, 1906.
Assistant General Manager, The Stacey Manufacturing Company, Station P, Cincinnati, Ohio.

Stacey, James E., October, 1906.
President, The Stacey Manufacturing Company, Station P, Cincinnati, Ohio.

Stites, Townsend, September, 1907.
General Manager, Welsbach Company, Gloucester, New Jersey.

Stone, Thomas W., October, 1906.
Engineer, Western Gas Construction Company, Buchanan Street, Fort Wayne, Indiana.

Storrs, Aaron Putnam, March, 1908. (P)
President, Storrs Mica Company, Owego, New York.

Storrs, Charles P., October, 1906. (P)
Secretary, Storrs Mica Company, Owego, New York.

Strause, Louis J., March, 1914. (N)
Secretary and Treasurer, Strause Gas Iron Company, 1425 Vine Street, Philadelphia, Pennsylvania.

Sullivan, Edward J., March, 1908.
Firm of Sullivan Brothers, 45 Main Street, Flushing, Long Island, New York.

Sullivan, William H., March, 1908. (P)
Firm of Sullivan Brothers, 45 Main Street, Flushing, Long Island, New York.

Taplin, Frank E., October, 1906.
President, Cleveland & Western Coal Company, Leader Building, Cleveland, Ohio.

Tatman, J. S., March, 1911.
With Connersville Blower Company, Connersville, Indiana.

Thompson, Robert John, September, 1914. (N)
Manager, Welsbach Company, 863 Mission Street, San Francisco, California.

Timm, Charles F., March, 1911. (P)
Salesman, Wm. M. Crane & Company, 16 West 32d Street, New York City; 46 Point Street, Yonkers, New York.

Tripp, Frank Foster, September, 1913.
Treasurer and General Manager, Automatic Gas Lighting Supply Company, 64 Warren Street, Roxbury, Massachusetts.

Tufts, Bowen, September, 1912.
Director, various gas companies, 78 Devonshire Street, Boston, Massachusetts.

Unger, John Samuel, March, 1914. (N) (P)
Mechanical and Chemical Engineer (Builder of the Unger Ammonia Still), 3344 Broadway, Chicago, Illinois.

Van Wie, Edwin, G., October, 1906.
Superintendent, Gas Appliance Department, Detroit Stove Works, 1320 Jefferson Avenue, Detroit, Michigan.

VAN WINKLE, WALTER H., September, 1913. (P)
Vice-President, Water Works Equipment Company, 50 Church Street, New York, New York.

WARDELL, CHAS. W., September, 1909. (P)
Illuminating Engineer, Welsbach Company, Gloucester, New Jersey.

WARREN, HENRY J., October, 1906.
President, Stamford Gas Stove Company, Box 388, Stamford, Connecticut.

WAY, JOHN G., March, 1909.
Manager, New Process Stove Company Division, American Stove Company, 4415 Perkins Avenue, Cleveland, Ohio.

WEBER, ALBERT J., October, 1906.
President, Adam Weber Sons, Manhattan Club, 26th and Madison Avenues, New York, New York.

WEHNER, ROBERT K., October, 1906. (P)
Treasurer, Isbell-Porter Company, Bridge and Ogden Streets, Newark, New Jersey.

WELLER, WILLIAM W., September, 1913. (P)
Manager of Sales, A. M. Byers Company, 235 Water Street, Pittsburgh, Pennsylvania.

WELLS, FRED K., October, 1906. (P)
Manager, Pittsburgh Water Heater Company of Massachusetts, 69 Broad Street, Boston, Massachusetts.

WENTZ, DANIEL B., March, 1914. (N)
President, Stonega Coke & Coal Company (Virginia), 1727 Land Title Building, Philadelphia, Pennsylvania.

WESTERMAIER, FRANCIS VICTOR, October, 1906. (P)
Engineer, Welsbach Street Lighting Company of America, 1934 Market Street, Philadelphia, Pennsylvania.

WHARTON, HENRY, October, 1906. (P)
Secretary, Westmoreland Coal Company, 224 South Third Street, Philadelphia, Pennsylvania.

WHETSTONE, WALTER, September, 1914. (N)
President, Whetstone & Company, Inc., 911 Filbert Street, Philadelphia, Pennsylvania.

WHITAKER, M. C., October, 1906.
Professor, Mechanical Science, Columbia University, New York, New York.

WICKHAM, LEIGH, October, 1906. (P)
Sales Agent, Parker-Russell Mining & Manufacturing Company, 501 Liggett Building, St. Louis, Missouri.

WILPUTTE, LOUIS, March, 1913.
Vice-President and General Manager, Otto Coking Company, 6 Church Street, New York, New York.

WILSON, EDWARDS F., October, 1906. (P)
Chief Chemist, Westmoreland Coal Company, Irwin, Pennsylvania.

WILSON, JOHN CROSIER, September, 1911. (P)
Engineer, Thomas Meter Department, Cutler-Hammer Manufacturing Company, 12th Street and St. Paul Avenue, Milwaukee, Wisconsin.

WITTE, LOUIS A., September, 1913.
Construction Engineer, Didier-March Company, Post Office Box 327, Perth Amboy, New Jersey.

WOOD, EDWARD R., JR., October, 1906.
Executor, 401 Chestnut Street, Philadelphia, Pennsylvania.

YOUNG, L. B., October, 1906. (P)
General Manager, The Michigan Stove Company, 1022 Jefferson Avenue, East, Detroit, Michigan.

YOUNG, N. A., March, 1909.
Secretary, James Gardner, Jr., Company, Lincoln Street, Bolivar, Pennsylvania.

YOUNGMAN, ROBERT H., September, 1910.
Assistant to President, Harbison-Walker Refractories Company, 1816 Farmers Bank Building, Pittsburgh, Pennsylvania.

ZITZEWITZ, HERMANN, October, 1906.
President, National Machine Works, Sheffield and North Avenues, Chicago, Illinois.

Total Associate Members 213

JUNIOR MEMBERS.

ALBURGER, ELMER R., September, 1908.
Constructor, United Gas Improvement Company, Broad and Arch Streets, Philadelphia, Pennsylvania.

Baldwin, Frederick R., September, 1912.
Superintendent's Assistant, Brooklyn Union Gas Company, 150 Sixth Avenue, Brooklyn, New York.

Barnes, Geo. J., March, 1909.
Philadelphia, Pennsylvania.

Baxter, Edw. O., September, 1908. (P)
Chief Clerk, Westchester Lighting Company, 67 North Broadway, Yonkers, New York.

Baylie, William Percival, September, 1913. (P)
Inspector of Accounts, Distribution Department, Philadelphia Gas Works, 24 North 22d Street, Philadelphia, Pennsylvania.

Beebe, Thomas Russell, September, 1907.
Commercial Engineer, Oxweld Acetylene Company, 1417 Morse Avenue, Chicago, Illinois.

Bennitt, George E., September, 1913.
Engineer's Assistant, Department of Utilization, Consolidated Gas Company of New York, 220 South Ninth Avenue, Mount Vernon, New York.

Bertolette, Norman Boone, September, 1914. (N)
Division Engineer, Philadelphia Suburban Gas & Electric Company, Post Office Box B, Wyncote, Pennsylvania.

Budde, John Henry, September, 1914. (N) (P)
Secretary to Construction Engineer, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Burnett, Frederick, October, 1906.
Assistant to Chief Engineer, Economical Gas Apparatus Construction Company, 165 King Street, Toronto, Ontario, Canada.

Butler, Joseph, September, 1914. (N)
Cadet Engineer, United Gas Improvement Company, 1711 Monument Avenue, Philadelphia, Pennsylvania.

Byrne, Thomas J., September, 1912. (P)
Superintendent's Assistant, Consolidated Gas Company of New York, 501 East 21st Street, New York, New York.

Call, Almon Eugene, September, 1912.
Assistant Engineer of Tests, Island Creek Coal Sales Company, 2015 Union Central Building, Cincinnati, Ohio.

Callahan, Cornelius F., September, 1913.
Assistant Superintendent, Old Colony Gas Company, Quincy Avenue, Weymouth, Massachusetts.

CALLAHAN, JOHN JOSEPH, March, 1911.
Foreman, New York & Richmond Gas Company, 694 Bay Street, Stapleton, Staten Island, New York.

CALLAWAY, GEORGE SAMUEL, September, 1912. (P)
Superintendent's Assistant, Equity Works, Brooklyn Union Gas Company, Maspeth and Porter Avenues, Brooklyn, New York.

CANON, FRANK ASHTON, March, 1914. (N)
Chemist, United Gas Improvement Company, 3914 North Percy Street, Philadelphia, Pennsylvania.

CARTER, CHARLES FREEMAN, March, 1913.
Cadet Engineer, Savannah Gas Company, 9 Congress Street West, Savannah, Georgia.

CHIDSEY, RAYMOND F., September, 1911.
Assistant Manager, Kingston Gas & Electric Company, 611 Broadway, Kingston, New York.

CLOEN, FRED, March, 1914. (N)
General Superintendent, Paducah Light & Power Company, 406 Broadway, Paducah, Kentucky.

COLES, SIDNEY S., September, 1913. (P)
Assistant to Engineer, Westchester Lighting Company, 1st Avenue and 1st Street, Mount Vernon, New York.

COLLIER, EDWARD CARLTON, March, 1913.
New Business Manager, Missoula Gas Company, 126 West Main Street, Missoula, Montana.

COLLINS, ARTHUR LIPPINCOTT, September, 1914. (N)
Cadet Engineer, United Gas Improvement Company, 143 School Lane, Germantown, Philadelphia, Pennsylvania.

COLTON, FRANCIS, March, 1914. (N) (P)
Assistant to Engineer, Public Service Construction Company, 30 Broad Street, New York, New York.

COOMBS, FRED S., October, 1906.
Superintendent, Meter Department, Youngstown Consolidated Gas & Electric Company, Post Office Box 58, Youngstown, Ohio.

COTTON, FRANCIS JOSEPH, March, 1914. (N) (P)
Superintendent's Assistant, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

CRANKSHAW, J. WARD, March, 1910.
Allentown Gas Company, Allentown, Pennsylvania.

CREEDEN, JOHN J., March, 1911.
Chief Clerk, General Fuel Appliance Department, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Cressler, Kerr Murray, October, 1906.
Assistant to Engineer, The Kerr Murray Company, Peoples Gas Building, Chicago, Illinois.

Crouse, William Thomas, March, 1914. (N)
Assistant Superintendent of Stores, United Gas Improvement Company, 19th Street and Allegheny Avenue, Philadelphia, Pennsylvania.

Crowell, Hugh Ramsay, September, 1914. (N) (P)
Engineer's Assistant, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Crowell, James Kenneth, September, 1908. (P)
Assistant to Engineer, Westchester Lighting Company, North Main Street, Portchester, New York.

Davis, E. B., March, 1909. (P)
Cadet, Distribution Department, Westchester Lighting Company, 134 South 11th Avenue, Mt. Vernon, New York.

Dickey, Philip S., March, 1912.
Foreman, Fitting Shop, Beloit Water, Gas & Electric Company, 429 East Grand Avenue, Beloit, Wisconsin.

Duncan, Howard William, September, 1912.
Superintendent, Northern Indiana Gas & Electric Company, 111 West LaPorte Street, Plymouth, Indiana.

Eichengreen, Leon B., March, 1913.
With Counties Gas & Electric Company, Ardmore, Pennsylvania.

Ellenberger, William M., March, 1914. (N)
Chief Draftsman, Records Division, Philadelphia Gas Works, 512 Fidelity Building, Philadelphia, Pennsylvania.

Ellis, R. L., March, 1913.
Superintendent, Selma Lighting Company, Selma, Alabama.

Farr, Riley William, Jr., March, 1912. (P)
Superintendent of Electric Construction, Northern Westchester Lighting Company, Box 224, Ossining, New York.

Felton, John Garrett, March, 1912. (P)
Engineer, Fulton County Gas & Electric Company, 107 3d Avenue, Gloversville, New York.

Field, Horace Hopkins, September, 1911.
Superintendent, Connecticut Power Company, 33 Union Street, New London, Connecticut.

Fitzpatrick, Daniel, October, 1906.
Foreman of Works, St. Augustine Gas & Electric Light Company, St. Augustine, Florida.

Ford, Andrew Joseph, September, 1914. (N) (P)
District Draftsman, Consolidated Gas Company of New York, 96 South 11th Street, Newark, New Jersey.

Ford, Charles McCabe, March, 1913. (P)
Chief Clerk and Assistant General Foreman, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

Fox, Charles J., October, 1906.
Superintendent of Distribution, Philadelphia Suburban Gas & Electric Company, 867 Main Street, Darby, Pennsylvania.

Galligan, James Edward, March, 1914. (N) (P)
General Foreman of Mains, Westchester Lighting Company, 127 Convent Place, Yonkers, New York.

Gellert, Nathan H., March, 1911.
Constructing Gas Engineer, 562 Winthrop Avenue, New Haven, Connecticut.

Gibbs, Tucker Carrington, March, 1914. (N)
Power Plant Engineer, Philadelphia Gas Works, United Gas Improvement Company, 2526 South Colorado Street, Philadelphia, Pennsylvania.

Gibson, James Coe, September, 1912.
Secretary-Treasurer and Manager, Labette Gas Company, Chetopa, Kansas.

Gonzalez, Américo Rodriguez, March, 1913.
Inspector of Lighting, Havana Electric Railway, Light & Power Company, Monte 1, Havana, Cuba.

Grant, Albert Weston, Jr., September, 1913.
Photometric Department, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Green, Albert, October, 1906.
General Foreman of Fitters, The United Gas Improvement Company, 4251 Romain Street, Philadelphia, Pennsylvania.

Green, J. W., October, 1906.
Superintendent, Westchester Lighting Company, First Avenue and First Street, Mount Vernon, New York.

Greene, Raymond Lewis, March, 1913. (P)
Assistant Superintendent, Brooklyn Union Gas Company, 556 Kent Avenue, Brooklyn, New York.

Griffin, Orange G., September, 1913.
Draughtsman, Consolidated Gas Company, 1854 Seventh Avenue, New York, New York.

Griffis, Rowland Elliot, September, 1913.
Inspector of Traffic Handling, Philadelphia Gas Works, United Gas Improvement Company, 24 North 22d Street, Philadelphia, Pennsylvania.

Griffiths, Chester A. A., March, 1914. (N)
Engineer's Assistant, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Griffiths, Norman James, September, 1913. (P)
Statistical Clerk, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Gross, Harry O., September, 1909.
Chief Clerk, Transportation Division, United Gas Improvement Company, 4650 Market Street, Philadelphia, Pennsylvania.

Haldeman, Clifford L., September, 1911.
District Main Foreman, Philadelphia Gas Works, 2920 North 26th Street, Philadelphia, Pennsylvania.

Hamilton, Earl R., September, 1911.
Chemical Engineer, Lowell Gas Light Company, 925 South Street, Roslindale, Massachusetts.

Hammond, Eric W., October, 1906.
Superintendent of Meter Repair Shop, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

Hansen, Alfred H., September, 1912.
Tar Salesman, Omaha Gas Company, 416 Woolworth Avenue, Omaha, Nebraska.

Harriman, Herbert E., September, 1912.
Superintendent of Works, Bangor Gas Light Works, 349 Main Street, Bangor, Maine.

Harris, Alan Hale, Jr., September, 1914. (N)
Engineer, Providence Gas Company, Turks Head Building, Providence, Rhode Island.

Hayward, Harold A., March, 1911. (P)
Assistant General Manager, Connelly Iron Sponge & Governor Company, 127 Duane Street, New York, New York.

Heavner, LeRoy Clements, March, 1911.
Engineer, Tampa Gas Company, Tampa, Florida.

Helman, Hiram, September, 1913.
Distribution Superintendent, Old Colony Gas Company, Quincy Avenue, East Braintree, Massachusetts.

Henson, Edward B., September, 1910.
Assistant Foreman, Gas Plant, San Antonio Gas & Electric Company, San Antonio, Texas.

Hill, Daniel L., March, 1911. (P)
Superintendent of Records, Toronto Gas Company, 19 Toronto Street, Toronto, Canada.

Hoff, John F., March, 1913. (P)
Superintendent, Public Service Gas Company, 45 Witherspoon Street, Princeton, New Jersey.

Hoffman, Armin Standish, March, 1914. (N)
Mechanical Engineer, B. P. Clapp Ammonia Company, 27th Street, between G and H Streets, N. W., Washington, District of Columbia.

Howard, Charles O. S., September, 1912. (P)
Hartford City Gas Light Company, 60 Front Street, Hartford, Connecticut.

Humphreys, Russell Garretson, March, 1914. (N)
Assistant in Engineering Department, Lawrence Gas Company, 370 Essex Street, Lawrence, Massachusetts.

Hunt, Harold William, September, 1914. (N)
Apprentice, Detroit City Gas Company, Station A, Detroit, Michigan.

Hyland, Harry B., March, 1914. (N)
Assistant Superintendent, Consolidated Gas Company, 66th Street and West End Avenue, New York, New York.

Innes, J. A., October, 1906.
Secretary and Treasurer, Citizens Light, Heat & Power Company, Eagle Grove, Iowa.

Jones, Charles C., March, 1914. (N)
General Foreman of Mains and Services, United Gas Improvement Company, 3334 North 21st Street, Philadelphia, Pennsylvania.

Jones, Leon B., September, 1912.
Assistant Engineer, Gas Department, Pacific Gas & Electric Company, Foot Humboldt Street, San Francisco, California.

Kane, Milford L., September, 1911.
Assistant Engineer, Sioux Falls Gas Company, Sioux Falls, South Dakota.

Kawai, Hideichi, September, 1912.
Ichigi, Takahashinuna Nishikamogun, Mikawa, Japan.

KEELER, EARL E., March, 1912.
General Shop Foreman, Kansas City Gas Company, 910 Grand Avenue, Kansas City, Missouri.

KELLOGG, HARRISON B., September, 1909.
Engineer, Westchester Lighting Company, 22 Cottage Place, Tarrytown, New York.

KILLGORE, JAMES N., March, 1913. (P)
Assistant Superintendent of Distribution, Public Service Gas Company, 35 Front Street, Newark, New Jersey.

KINGSBURY, I. CLAYTON, March, 1909.
Assistant Superintendent, Mains and Services, Consolidated Gas Company of New York, 111th Street and 1st Avenue, New York, New York.

KLAR, ROBERT LYLE, March, 1914. (N)
Power Plant Engineer, Philadelphia Gas Works, 5524 Chew Street, Germantown, Philadelphia, Pennsylvania.

KNAUSS, DOUGLAS STANLEY, March, 1914. (N) (P)
Cadet Engineer, Philadelphia Gas Works, 5861 Hadfield Street, Philadelphia, Pennsylvania.

KNOTHE, W. J., October, 1906.
Engineer, Evens & Howard Fire Brick Company, 920 Market Street, St. Louis, Missouri.

KOLLOCK, EDWARD CAMPBELL, March, 1913.
Superintendent, Gas Department, Charleston Consolidated Railway & Lighting Company, 141 Meeting Street, Charleston, South Carolina.

KRUGER, PAUL, September, 1914. (N) (P)
Prepayment Bookkeeper, Westchester Lighting Company, 558 East 191st Street, New York, New York.

LAFORE, PAUL JULES, September, 1909.
Inspector of Fuel Appliances, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

LEUENBERGER, WALTER ARNOLD, March, 1908.
Superintendent, Tacoma Gas Company, 101 South 10th Street, Tacoma, Washington.

LOUD, ROGER PERKINS, March, 1912.
87 Commercial Street, Weymouth, Massachusetts.

MACSAVENY, ROBERT, JR., March, 1914. (N) (P)
Night Foreman, Brooklyn Union Gas Company, Foot North 12th Street, Brooklyn, New York.

McCarthy, Albert P., March, 1911.
Engineer, Philadelphia Suburban Gas & Electric Company, Coatesville, Pennsylvania.

Malakoff, John, September, 1912. (P)
General Foreman, Gas Works, Westchester Lighting Company, Spring Street, White Plains, New York.

Malin, J. H., September, 1912.
Storekeeper, Omaha Gas Company, 1202 Howard Street, Omaha, Nebraska.

Maloney, George Joseph, March, 1914. (N)
Superintendent, Kennett Gas Company, Kennett Square, Pennsylvania.

Marsh, Edward H., September, 1913. (P)
Shop Foreman, Queens Borough Gas & Electric Company, 347 Central Avenue, Far Rockaway, New York.

Mayfield, Paul C., March, 1914. (N)
Assistant Superintendent, Philadelphia Gas Works, United Gas Improvement Company, 2322 North Park Avenue, Philadelphia, Pennsylvania.

Miller, Miss Anna Virginia, October, 1906.
Demonstration Cooking Lecturer, 1237 Harrison Street, Kansas City, Missouri.

Minard, Emory D., September, 1913. (P)
General Foreman, Public Service Gas Company, 118 Main Street, Hackensack, New Jersey.

Mitchell, Herman W., March, 1914. (N)
Cashier and Office Manager, Rome Gas, Electric Light & Power Company, 139 North James Street, Rome, New York.

Mitchell, Wylie, March, 1914. (N)
Superintendent Distribution, St. Joseph Gas Company, 802 Francis Street, St. Joseph, Missouri.

Morrison, Martin, September, 1912. (P)
Candle-Power Inspector and Cadet Engineer, Westchester Lighting Company, 216 North 6th Avenue, Mount Vernon, New York.

Moyer, Wayne R., September, 1913.
Assistant Superintendent, Spring Garden District, United Gas Improvement Company, 446 West Martin Street, Roxborough, Philadelphia, Pennsylvania.

MUELLER, ADOLPH F., March, 1910.
Head Bookkeeper, Seattle Lighting Company, Seattle, Washington.

MULLER, HERMAN, JR., September, 1908. (P)
Works Assistant, New York & Richmond Gas Company, 691 Bay Street, Stapleton, Staten Island, New York.

MURPHY, ALBERT FRANCIS, September, 1912. (P)
Assistant to Superintendent, Brooklyn Union Gas Company, 176 Remsen Street, Brooklyn, New York.

MURPHY, HAROLD PURVES, March, 1914. (N)
Cadet Engineer, United Gas Improvement Company, 116 West Penn Street, Germantown, Philadelphia, Pennsylvania.

NASON, FOREST J., September, 1913.
Clerk, Haverhill Gas Light Company, Haverhill, Massachusetts.

NEAL, GEORGE A., September, 1912.
Engineer's Assistant, Allentown-Bethlehem Gas Company, 111 South Main Street, Bethlehem, Pennsylvania.

NELSON, E. A., March, 1909. (P)
Engineering Assistant of Mains and Services, Consolidated Gas Company of New York, 80 Elizabeth Street, New York, New York.

NELSON, WILLIAM HARRIS, March, 1914. (N)
Cadet Engineer, St. Paul Gas Light Company, 6th and Jackson Streets, St. Paul, Minnesota.

NETH, JOHN A., October, 1906. (P)
Foreman, Gas Department, Westchester Lighting Company, 14 Archer Park, Tarrytown, New York.

NISSLEY, WARREN W., September, 1914. (N)
New Business Manager, Nassau & Suffolk Lighting Company, Hempstead, Long Island, New York.

O'KEEFFE, JAMES GARWOOD, March, 1908. (P)
Market Street Works, Public Service Gas Company, Newark, New Jersey.

ORDISH, T. BRANDON, October, 1906.
Assistant Superintendent, Lansing Fuel & Gas Company, 224 West Maple Street, Lansing, Michigan.

PALMER, ALVA L., September, 1913.
Engineer's Assistant, Department of Utilization, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

PATTERSON, CLEMENT F., September, 1911.
143 North Washington Avenue, Whittier, California.

PEARCE, WILLIAM FAULKNER, March, 1908.
With Montreal Light, Heat & Power Company, 177 Harbour Street, Montreal, Canada.

PEDEN, H. L., March, 1909.
Assistant Superintendent, Distribution Department, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

PERKINS, MATTHEW F., September, 1909.
Chief Canvasser, United Gas Improvement Company, 5813 Thompson Street, Philadelphia, Pennsylvania.

PFEIFFER, BERNARD V., September, 1911.
Engineer, Nashville Gas & Heating Company, 611 Church Street, Nashville, Tennessee.

PLATT, LOUIS JULIUS, September, 1914. (N)
Industrial Fuel Representative, Public Service Gas Company, Public Service Corporation Building, Newark, New Jersey.

POSTLES, JOHN V., September, 1913.
Cadet Engineer, 115 South 22d Street, Philadelphia, Pennsylvania.

PRICE, WILLIAM H., October, 1906.
Draftsman and Clerk, Providence Gas Company, 93 Georgia Avenue, Providence, Rhode Island.

PUGH, FRANK S., September, 1914. (N)
Foreman of Mains and Services, Porto Rico Gas Company, Fernland Farm, Rio Piedras, Porto Rico.

RASCH, WM. T., March, 1909.
Assistant to Engineer of Utilization, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

REILEY, FREDERICK ASBURY, March, 1914. (N)
Engineering Assistant, United Gas Improvement Company, Waterbury, Connecticut.

REINER, OTTO, September, 1912. (P)
General Foreman, Public Service Gas Company, 41 Front Street, Newark, New Jersey.

Reynolds, James Fisher, September, 1913. (P)
Industrial Salesman, Consolidated Gas Company, 30 East 42d Street, New York, New York.

Rhoads, William Henry, September, 1913. (P)
Engineer's Assistant, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Richardson, R. B., September, 1914. (N)
Works Superintendent, Decatur Railway & Light Company, Decatur, Illinois.

Riordan, Daniel, March, 1913.
Chief Clerk in Works Office, Consolidated Gas Company, 501 East 21st Street, New York, New York.

Ritchie, Arthur Robson, March, 1911. (P)
Superintendent, Consolidated Gas Company, 14th Street and Avenue C, New York, New York.

Roberson, Jay C., March, 1913. (P)
Superintendent of Distribution, Public Service Gas Company, Peace and Washington Streets, New Brunswick, New Jersey.

Robinson, Chauncey D., September, 1911.
Sales Representative, Diamond Rubber Company, Broad and Spring Garden Streets, Philadelphia, Pennsylvania.

Russell, James, September, 1913.
Assistant Chief Draughtsman, United Gas Improvement Company, 3141 North 17th Street, Philadelphia, Pennsylvania.

Schell, William F., March, 1913.
Philadelphia Company, 435 Sixth Avenue, Pittsburgh, Pennsylvania.

Schlegel, Carl A., September, 1913. (P)
Engineer, Construction Department, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

Schroeder, Carl Robert, March, 1912. (P)
Cadet Engineer, Distribution Department, Public Service Gas Company, 1045 Bloomfield Street, Hoboken, New Jersey.

Schroeder, Charles Scheren, September, 1914. (N) (P)
Assistant Chief Draftsman, Department of Mains and Services, Consolidated Gas Company of New York, 130 East 15th Street, New York, New York.

Schuck, Conrad, Jr., March, 1911. (P)
Assistant Superintendent, Public Service Gas Company, 258 North Park Street, East Orange, New Jersey.

Scott, William Doke, March, 1914. (N)
Engineering Assistant, Syracuse Lighting Company, Syracuse, New York.

Seeley, Harold K., September, 1913.
Assistant Superintendent, City District, United Gas Improvement Company, 1931 South 9th Street, Philadelphia, Pennsylvania.

Shaughnessy, Thomas, Jr., September, 1912. (P)
Engineer's Assistant, Consolidated Gas Company, 130 East 15th Street, New York, New York.

Sheehy, John Charles, September, 1911. (P)
Distribution Foreman, Queens Borough Gas & Electric Company, 347 Central Avenue, Far Rockaway, New York.

Sherwood, Herbert, September, 1910. (P)
Superintendent, Westchester Lighting Company, 119 Woodworth Avenue, Yonkers, New York.

Smith, George Howard, March, 1914. (N)
Assistant District Superintendent, Central Hudson Gas & Electric Company, 129 Broadway, Newburgh, New York.

Smith, George Lathrop, September, 1913.
Assistant Superintendent, West Philadelphia District, United Gas Improvement Company, 1039 South 51st Street, Philadelphia, Pennsylvania.

Smith, George Oliver, September, 1914. (N)
Supervisor of Safety, Doherty Operating Company, 60 Wall Street, New York, New York.

Smith, Oliver Hobson, September, 1914. (N)
Assistant Superintendent, New Amsterdam Gas Company, Ravenswood Works, Long Island City, New York.

Sommar, Alban M., March, 1913.
Chief Clerk, Savannah Gas Company, Post Office Box 426, Savannah, Georgia.

Sprau, Robert Lee, September, 1912.
Assistant Superintendent, Louisville Gas & Electric Company, 1108 Logan Street, Louisville, Kentucky.

Steere, Frank W., September, 1914. (N) (P)
Technical Assistant to Superintendent, Semet-Solvay Company, Detroit, Michigan.

STURDEVANT, WALTER, September, 1914. (N)
Assistant in General Superintendent's Department, United Gas Improvement Company, 4530 Regent Street, Philadelphia, Pennsylvania.

TALL, GEORGE WASHINGTON, JR., September, 1914. (N)
Cadet Engineer, United Gas Improvement Company, 509 Woodlawn Road, Roland Park, Maryland.

TARRANT, STANLEY G., March, 1912. (P)
Statistician, Westchester Lighting Company, 1st Avenue and 1st Street, Mount Vernon, New York.

TAYLOR, PERCIVAL DRAYTON, March, 1914. (N)
Engineer, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

TENNEY, GEORGE C., March, 1912.
Mechanical Engineer, Public Service Gas Company, 33 Prospect Street, Elizabeth, New Jersey.

TINNEY, THOMAS BROWN, March, 1913.
Chemist, United Gas Improvement Company, 303 Lafayette Avenue, Collingdale, Pennsylvania.

TOBIAS, WILLIAM A., September, 1912.
Foreman of Gas Distribution, Mohawk Gas Company, Schenectady, New York.

TOUR, REUBEN S., March, 1912.
Assistant Professor of Gas Engineering, University of California, Mechanics Building, Berkeley, California.

TOZIER, GEORGE E., September, 1914. (N)
Distribution Foreman, Henrico County Gas Company, 900 North Avenue, Barton Heights, Richmond, Virginia.

TRAVIS, GEORGE W. LEROY, September, 1912. (P)
Assistant Engineer, Department Mains and Services, Consolidated Gas Company, 130 East 15th Street, New York, New York.

VAN VLIET, RUTHERFORD, September, 1914. (N)
Apprentice, Detroit City Gas Company, Station B, Detroit, Michigan.

VECKER, SAMUEL P., March, 1912.
Manager, Key West Gas Company, Fleming and Simonton Streets, Key West, Florida.

VETTERS, WALTER W., September, 1914. (N)
Works Foreman, Henrico County Gas Company, Barton Heights, Richmond, Virginia.

WARNER, CHARLES PIERIE, March, 1910.
Cadet Engineer, United Gas Improvement Company, 1401 Arch Street, Philadelphia, Pennsylvania.

WHIPPLE, ROBERT H., March, 1913.
Engineering Department, American Gas Company, West Washington Square, Philadelphia, Pennsylvania.

WHITE, WILLIAM MORSE, March, 1912.
Superintendent, Coke Oven Department, Philadelphia Suburban Gas & Electric Company, 2503 West Fourth Street, Chester, Pennsylvania.

WILLIAMSON, JOHN A., March, 1914. (N) (P)
Assistant Superintendent of Construction, Peoples Gas Light & Coke Company, Peoples Gas Building, Chicago, Illinois.

WILSON, CHARLES JAMES, March, 1914. (N)
Industrial Department, Laclede Gas Light Company, 11th and Olive Streets, St. Louis, Missouri.

WILSON, WARD, October, 1906.
Foreman of Distribution, Lynchburg Traction & Light Company, 316 Euclid Avenue, Lynchburg, Virginia.

WIMBERLY, ALBERT HOMER, September, 1914. (N)
Foreman, Distribution Shop, Atlanta Gas Light Company, Electric and Gas Building, Atlanta, Georgia.

WISKE, PRESCOTT B., March, 1913. (P)
Superintendent's Assistant, Brooklyn Union Gas Company, 5th and Hoyt Streets, Brooklyn, New York.

WOOD, FRANK A., September, 1912.
7 Florida Street, Dorchester, Massachusetts.

WOODROFFE, WILLIAM P., September, 1911.
191 Garfield Place, Brooklyn, New York.

WRIGHT, WILLIAM GANO, September, 1912.
Street Clerk, Westchester Lighting Company, 119 Woodworth Avenue, Yonkers, New York.

ZANE, ALLEN HERBERT, March, 1914. (N)
Superintendent's Assistant, Astoria Light, Heat & Power Company, Astoria, Long Island, New York.

ZOOK, SAMUEL KURTZ, October, 1906.
Superintendent, Public Service Gas Company, Washing and Peace Streets, New Brunswick, New Jersey.

Total Junior Members 182

SUMMARY.

Honorary	4
Life	1
Active	1,128
Associate	213
Junior	182
Total	1,528

MEMBERS OF THE AMERICAN GAS INSTITUTE ARRANGED GEOGRAPHICALLY

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BESSEMER
Harry Firstbrook.

BIRMINGHAM
A. H. Ford.
J. E. Montgomery.

MOBILE
Albert F. Kersting.

SELMA
R. L. Ellis.

WOODWARD
John Drewson.

Arkansas

LITTLE ROCK
W. F. Booth.

California

BERKELEY
Reuben S. Tour.

JACKSON
B. E. Letang.

LOS ANGELES
Robert M. Adams.
F. R. Bain.
William Baurhyte.
Jos. M. Berkley.
Henry W. Burkhart.
W. B. Cline.
John T. Creighton.
Addison B. Day.
William J. Dorr.
Robt. F. Fitz.
J. D. Hackstaff.
Charles P. Houghton.
Charles A. Luckenbach.
A. B. Macbeth.
Thomas P. McCrea.
Frederick Charles Millard.
C. S. Vance.
Wm. M. Welch.

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Frank A. Cressey, Jr.

OAKLAND
F. A. Leach, Jr.

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C. W. Koiner.

SACRAMENTO
E. S. Jones.

SAN DIEGO
Henry H. Jones.

SAN FRANCISCO
John A. Britton.
V. E. Britton.
Frank Cavenagh.
W. M. Henderson.
Edward C. Jones.
Leon B. Jones.
D. E. Keppelmann.
John Martin.
C. O. G. Miller.
Saml. L. Naphtaly.
R. J. Thompson.
Wm. McN. Welsh.

SAN JOSE
Robert H. Hargreaves.
John D. Kuster.

California—(*Continued*)

SANTA MONICA
W. H. Bettle.
W. S. Dole.

SEARLES
John W. Hornsey.

UPLAND
Isaac C. Baxter.

WHITTIER
C. F. Patterson.

Colorado

DENVER
John T. Brady.
R. G. Griswold.
M. E. Malone.
Clare N. Stannard.
A. F. Traver.

PUEBLO
James M. Dailey.
C. C. Durkee.

Connecticut

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C. M. Gerdenier.
Wm. P. Hutchinson.
Ralph I. Munson.
A. J. Palmer.
Geo. W. Roberts.
H. H. Sprague.

DANBURY
George E. Cowperthwaite.

DERBY
Chas. H. Nettleton.
George H. Scranton.

HARTFORD
C. O. S. Howard.
B. W. Perkins.
C. M. Willis.

MERIDEN
Charles A. Learned.

MIDDLETOWN
Edgar C. Weston.

MILFORD
William Reeves.

NEW HAVEN
Philmer Eves.
N. H. Gellert.
J. Arnold Norcross.
T. R. Sucher.
Clarence E. Thompson.
Robert E. Wyant.

NEW LONDON
V. E. Bird.
H. H. Field.

ROCKVILLE
William Morgan Lewis.

STAMFORD
Henry J. Warren.
John A. Waters.

STEPNEY DEPOT
F. B. Wheeler.

THOMPSON
C. L. Gerould.

THOMPSONVILLE
W. P. Schwabe.

TORRINGTON
Frank M. Travis.

WATERBURY
Alex. J. Campbell.
F. A. Reiley.
E. H. Williams.

Delaware

WILMINGTON
Wm. J. McCorkindale.

District of Columbia

WASHINGTON
C. Clay Bayly.
Frederic Egner.
A. S. Hoffman.
Thomas F. Holden.
James S. McIlhenny.
Robert L. Middleton.
Howard Reeside.
T. Symmes Tincher.
Sanford N. Whitwell.

Florida

JACKSONVILLE
Clarence S. Hammatt.
Harry B. Hoyt.
David S. Long.

KEY WEST
S. P. Vecker.

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Chas. W. Hunter.

PENSACOLA
Charles F. Zeek.

ST. AUGUSTINE
Daniel Fitzpatrick.
C. L. Lyon.

ST. PETERSBURG
F. B. Crowell

TAMPA
LeRoy C. Heavner.
Rosco Nettles.

Georgia

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P. S. Arkwright.
Richard C. Congdon.
J. E. Fulweiler.
C. R. Miller.
Carter H. Page, Jr.
C. J. Weinmeister.
A. D. Whittaker.
A. H. Wimberly.

AUGUSTA
F. L. Marshall.
Morris D. Schindler.

COLUMBUS
MacDougald Dexter.

MACON
George R. Horning.

ROME
James Ferrier.

SAVANNAH
J. L. Cabell.
C. F. Carter.
John W. Golden.
J. C. Grey.
Alban M. Sommar.

Idaho

BOISE
Chas. M. Eyman.
O. G. F. Markhus.

Illinois

AURORA
I. C. Copley.
F. M. James.
P. O'Malley.
Carroll Miller.
R. N. Strohn.

CHICAGO
Knowlton L. Ames.
C. F. Asendorf.
Wm. A. Baehr.
T. R. Beebe.
R. W. Bingham.
Chas. W. Bradley.
D. H. Brush, Jr.
F. S. Carnes.
Alfred A. Chichester.
H. H. Clark.
R. K. Clark.
Mathias Connors.
Edward G. Cowdery.
A. D. Cressler.
A. M. Cressler.
G. H. Cressler.
K. M. Cressler.
C. F. Daniels.
James E. Davies.
R. N. Davis.
H. M. Dawes.
Rufus C. Dawes.
C. L. Day.
Alfred B. Eaton.
L. B. Elliott.
I. C. Elston, Jr.
F. J. Ely.

Illinois—(*Continued*)

CHICAGO

Ralph Esau.
John H. Eustace.
Albert L. Farr.
J. F. Gilchrist.
John Ginley.
H. D. Harper.
R. B. Harper.
Julian G. Hart.
W. E. Hartman.
Homer T. Hirst, Jr.
Jesse B. Hirst.
Eugene A. Hults.
H. R. Hunt.
William B. Jackson.
Benjamin J. Kellum.
Wm. J. Knapp.
Henry Koppers.
F. A. Lathrop.
J. W. Lawlor.
Henry I. Lea.
Thomas J. Lucas.
A. J. Luick.
F. E. Luther.
J. N. McCallum.
N. A. McClary.
F. G. Manly.
Joseph C. Markley.
William P. Martin.
Charles W. Melcher.
T. D. Miller.
Thomas N. Mordue.
John M. Morehead.
Edward E. Morrell.
Wm. J. Norton.
H. L. Olds.
George G. Olmsted.
Otto E. Osthoff.
F. E. Park.
Dudley W. Penington.
L. R. Phillips.
Edward G. Pratt.
Theo. V. Purcell.
James A. Rafferty.
Charles J. Ramsburg.
Richard Rees.
S. A. Reinhard.
Chas. E. Reinicker.
Irwin Rew.
Daniel Roesch.
Rudolph Schenck.
C. C. Schiller.
Samuel C. Shaffner.
Jacob M. Spitzglass.
W. D. Sweetman.
J. S. Unger.
Lyman A. Wiley.
J. A. Williamson.
John Williamson.
Herman Zitzewitz.

DECATUR

Robert Mueller.
R. B. Richardson.

DEKALB

E. S. Davidson.

DIXON

Edward W. Galloway.
Justin E. Harlow.

EAST ST. LOUIS

Charles H. Quackenbush.

ELGIN

C. B. Strohm.

EVANSTON

Andrew McIntyre.

FREEPORT

E. D. V. Dickey.

JOLIET

H. J. Mitchell.
C. E. Underwood.

KANKAKEE

F. E. Newberry.

KEWANEE

Elmer W. Smith.

LA GRANGE

R. C. Graveley.

Illinois—(*Continued*)

OAK PARK
Mathias Britsch.

PEORIA
H. E. Chubbuck.
Ross S. Wallace.

QUINCY
Harry O. Channon.
Charles McDonnell.

ROCKFORD
C. W. Butterworth.
A. W. Kendall.
Garnet W. McKee.
J. F. Parker.
George D. Roper.
Henry S. Whipple.
S. G. Smith.
W. A. Wilson.

SOUTH CHICAGO
W. H. Allen, Jr.

SPRINGFIELD
A. S. B. Little.
C. H. Lanphier.

WAUKEGAN
H. T. Crawford.
George F. Goodnow.
W. R. Knapp.

Indiana

ANDERSON
M. G. Reynolds.

AUBURN
Byron H. Danforth.

COLUMBUS
H. M. Eaton.
C. M. Keller.

CONNERSVILLE
George C. Hicks, Jr.
E. D. Johnston.
J. S. Tatman.

ELKHART
J. A. Patten.

EVANSVILLE
J. C. Silverthorn.

FORT WAYNE
Olaf N. Guldlin.
G. Max Hofmann.
Lothar Hofmann.
S. E. Mulholland.
Thomas W. Stone.
Orrell O. Thwing.
John V. Wills.

GARY
David Elder.
Leonard Fitzgerald.

GREENCASTLE
John G. Martin.

HAMMOND
A. S. Graham.
H. C. Miller.
William D. Ray.

INDIANAPOLIS
H. M. Chapman.
Frank W. Sargeant.
George Summers.
W. H. Wright.

LAFAYETTE
Isaac Battin.
Wm. I. Battin.
S. T. Murdock.

LOGANSPORT
George M. Dolley.

MARION
D. S. Milne.

MICHIGAN CITY
Chester N. Chubb.
H. V. Armstrong.

MUNCIE
J. E. Colvin.
J. H. Maxon.

NEW ALBANY
James W. Dunbar.

NOBLESVILLE
R. H. Lawlor.

Indiana—(*Continued*)

PLYMOUTH
Howard W. Duncan.

SOUTH BEND
Edw. B. Myers.
Benj. S. Walters.

TERRE HAUTE
Alfred S. Cooke.
C. D. Shaul.

VALPARAISO
LeRoy O. Gordon.

Iowa

BOONE
H. G. Stillson.

BURLINGTON
Edward D. Clary.

CEDAR RAPIDS
E. L. Lambert.
Thomas Suchomel.

CHARLES CITY
R. K. Runner.

CLINTON
Thomas Crawford.

COUNCIL BLUFFS
A. L. English.

DAVENPORT
Hubert C. Blackwell.
D. G. Fisher.
Ernest Jacobson.
Joseph F. Porter.

DES MOINES
T. Bertram Genay.
Jansen Haines.
E. H. Martin.
Emil G. Schmidt.
W. H. Thomson, Jr.
G. I. Vincent.

DUBUQUE
George McLean.
E. M. Walker.

EAGLE GROVE
J. A. Innes.

FORT DODGE
R. M. Parker.

MUSCATINE
Edw. M. Walker.

SIOUX CITY
Wm. J. Bertke.
Leonard L. Kellogg.

WASHINGTON
George S. Carson.

WATERLOO.
Austin Burt.
H M. Smith.

WEBSTER CITY
Campbell W. Fair.

Kansas

CHETOPA
James C. Gibson.

KANSAS CITY
W. H. McKenzie.
C. H. Waring.

TOPEKA
George J. Swan.
L. G. Treleaven.

Kentucky

HOPKINSVILLE
R. A. Field.

LOUISVILLE
A. H. Barret.
William H. Crutcher.
Geo. H. Harries.
Frank Huber.
Donald McDonald.
Robt. L. Sprau.
Harry R. Swann.

PADUCAH
Fred Cloen.

RICHMOND
Benj. A. Dougherty.

Louisiana

HAMMOND
F. W. Reimers.

NEW ORLEANS
Geo. H. Davis.
H. M. Harriman.
R. John Titzel.
Wm. vonPhul.

Maine

AUGUSTA
Walter S. Wyman.

BANGOR
Herbert E. Harriman.
O. A. Merchant, Jr.

BIDDEFORD
Saml. L. Parcher.

HARPSWELL
E. E. Witherby.

LEWISTON
John J. Scott.

PORTLAND
Fred N. Dow.
C. O. Pratt.

WATERVILLE
L. L. Cadwallader.

Maryland

BALTIMORE
George R. Althen.
George Beadenkopf.
Howard Bruce.
C. H. Claiborne.
Charles M. Cohn.
Charles H. Dickey.
Edmund S. Dickey.
E. Bartlett Hayward.
E. S. Newbold.
George P. Marrow.
L. Irving Pollitt.
Louis N. Rancke.
Edward L. Rieha.
Albert Rosenthal.
R. S. Scott.
Carl C. Thomas.
Fred H. Wagner.

FREDERICK
J. H. Enright.

ROLAND PARK
G. W. Tall, Jr.

Massachusetts

ATTLEBORO
William J. Luther.

BEVERLY
C. R. Prichard.

BOSTON
Perry Barker.
W. B. Calkins.
Herbert N. Cheney.
Alfred Clarke.
F. N. Eisenman.
N. W. Gifford.
John A. Gould.
Robert Grant.
Chas. W. Hunter.
D. C. Jackson.
Wm. J. Lavelle.
A. D. Little.
W. E. McKay.
D. E. Manson.
Arthur E. Norton.
Harry A. Norton.
Edward Page.
Alfred R. Patterson.
Theo. H. Piser.
J. L. Richards.
Frederick P. Royce.
Howard T. Sands.
Albert B. Tenney.
Bowen Tufts.
Hans von Vittinghoff.
P. B. Webber.
F. K. Wells.
William Austin Wood.
Edgar N. Wrightington.

BROCKTON
J. S. String.

CAMBRIDGE
Albert M. Barnes.
J. P. Kennedy.

Massachusetts—(*Continued*)

CHARLESTOWN
Samuel J. Fowler.

DORCHESTER
F. A. Wood.

EAST BOSTON
N. W. Gifford.

EAST BRAINTREE
Hiram Helman.
Geo. P. Smith, Jr.

EAST CAMBRIDGE
Isaac T. Haddock.

EVERETT
Howell Fisher.
Robert M. Folsom.
J. M. McClellon.
Alexander B. Way.
John F. Wing.

FALL RIVER
R. Buckminster.
R. B. Clark.
Joseph E. Nute.

FITCHBURG
Clifton R. Hayes.
George W. Stiles.

FRAMINGHAM
George H. Priest.

HAVERHILL
Forest J. Nason.
Charles Otten, Jr.
F. M. Roberts.

HOLYOKE
O. W. Adams.

LAWRENCE
C. J. R. Humphreys.
R. G. Humphreys.
W. M. McQueston.
Fred H. Sargent.
H. G. Taylor.

LOWELL
W. B. Osborne.

LYNN
F. E. Drake.
H. K. Morrison.

MALDEN
C. E. Paige.

NEW BEDFORD
Robert Lindsay.
Wm. H. Snow.

NEWTON
Waldo A. Learned.

PITTSFIELD
Harry C. Crafts.

QUINCY
Wm. B. Nichols.

ROSLINDALE
E. R. Hamilton.

ROXBURY
F. F. Tripp.

SALEM
J. L. Tudbury.

SPRINGFIELD
Benjamin P. Bill.
Wallace H. Bradley.
Herman Burgi.
Charles H. Tenney.

WAKEFIELD
Albert B. Morton.

WEBSTER
H. S. Shaw.

WEYMOUTH
Cornelius F. Callahan.
R. P. Loud.

WINCHESTER
Chas. W. Hinman.

WORCESTER
Dana D. Barnum.
Charles Dudley Lamson.

Michigan

ANN ARBOR
Henry W. Douglas.
Alfred H. White.

Michigan—(*Continued*)

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F. K. Berry.
D. H. Frazer.

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Samuel Ball.

BENTON HARBOUR
Edward Olsen.

BIG RAPIDS
R. Shacklette.

DETROIT
Abram T. Baldwin.
William Tefft Barbour.
J. W. Batten.
Warren S. Blauvelt.
Dwight F. Burritt.
M. H. Cutcheon.
V. F. Dewey.
Alonzo P. Ewing.
Wm. S. Guitteau.
Wm. G. Henry.
H. W. Hunt.
Ralph A. Jayne.
E. H. Jewett.
George I. Keal.
Nathan G. Leakey.
Alfred G. Lloyd.
Ernest F. Lloyd.
James T. Lynn.
J. N. McCallum.
George Osius.
Charles S. Ritter.
Henry D. Schall.
C. A. Schwarm.
A. F. Shattuck.
Otis A. Sinsel.
F. W. Steere.
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R. Van Vliet.
Edwin G. Van Wie.
A. L. Wilkinson.
Leigh E. Worthing.
L. B. Young.

GRAND RAPIDS
Jos. H. Brewer.
Glenn R. Chamberlain.
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John Hellen.
Frank T. Hulswit.
Jno. A. Hulswit.
Chas. B. Kelsey.
Richard Schaddelee.
Albert G. Schroeder.
Frederick Seymour.
Albert I. Snyder.
T. J. Weber.
John T. Young.

JACKSON
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W. M. Eaton.
B. R. Laraway.
C. W. Tippy.

KALAMAZOO
Walter M. Blinks.
Frank W. Blowers.
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J. J. Knight.

LANSING
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T. B. Ordish.

MARQUETTE
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Carroll Collins.

PORT HURON
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James Trimble.

Minnesota

CROOKSTON
H. M. Moore.

DULUTH
C. W. Andrews.

FARIBAULT
B. W. Cowperthwait.

Minnesota—(*Continued*)

MANKATO
Robert. E. Brown.

MINNEAPOLIS
Frederick C. Shepard.

ST. PAUL
John P. Crowley.
Paul Doty.
D. W. Flowers.
Ole S. Johnson.
W. H. Nelson.
Bert. F. Pelton.
George Steinwedell.
H. B. Stiles.

WINONA
Wm. F. Clausen.

Mississippi

JACKSON
Raymond H. Smith.

VICKSBURG
John J. Gannon.

Missouri

BOONVILLE
W. E. Sombart.

EXCELSIOR SPRINGS
Saml. W. Henderson.

INDEPENDENCE
Robert S. Miller.

JOPLIN
B. J. Crahan.

KANSAS CITY
E. L. Brundrett.
E. W. Hammond.
A. Hurlburt.
E. E. Keeler.
Miss Anna Virginia Miller.
F. F. Schauer.
John M. Scott.
M. M. Sweetman.
William M. Wood.

SEDALIA
H. D. Frueauff.

ST. CHARLES
Lee G. Stealey.

ST. JOSEPH
V. L. Elbert.
Wylie Mitchell.

ST. LOUIS
J. J. Burns.
F. G. Curfman.
Augustin J. Daly.
John Dell.
A. C. Einstein.
Geo. B. Evans.
R. D. Hatton.
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Donald MacArthur.
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Robert Seeger.
Jacob D. von Maur.
H. C. Wehnert.
W. H. Whitton.
Leigh Wickham.
C. J. Wilson.

WEBSTER GROVES
J. E. Hillemeyer.
S. H. Wallace.

Montana

BILLINGS
Ira C. Covert.

BOZEMAN
Arthur W. Richter.

MISSOULA
Edward C. Collier.
D. C. Plank.

Nebraska

FREMONT
W. H. Merritt.

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A. W. Borden.

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G. W. Clabaugh.
John C. Grey.
Alfred H. Hansen.
Joseph Lucena.
J. H. Malin.
Wm. H. Taylor.

New Hampshire

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A. J. Smith.

KEENE
G. M. Rossman.

MANCHESTER
Walter G. Africa.
Alex. H. Scott.

NASHUA
Walter F. Norton.

New Jersey

ATLANTIC CITY
Carlton Geist.

ATLANTIC HIGHLANDS
R. H. Garrison.

BAYONNE
W. G. Mackenzie.
H. A. Wheeler.

BELMAR
Joseph Mayer.

BURLINGTON
Edward Hering.

CAMDEN
John J. Burleigh.
George W. Curtis.
James N. Downey.
Harry Ellis.
George Hobdell.
Thomas Littlehales.
E. F. Miller.
E. A. Moore.
J. A. Riggins.
Wm. J. Rodgers.

DOVER
Seth H. Ely.

EAST ORANGE
Conrad Schuck, Jr.

ELIZABETH
Roger Crilley.
Francis Engel.
G. C. Tenney, Jr.

GLASSBORO
Charles W. Hoy.

GLOUCESTER CITY
F. G. Corbus.
F. N. Hamerstrom.
Thomas J. Litle, Jr.
Wm. P. McCoy.
Townsend Stites.
C. W. Wardell.

HACKENSACK
Emory D. Minard.
E. C. Roberts.
Chas. J. Roeser.

HOBOKEN
Albert F. Ganz.
W. Greacen, Jr.
C. R. Schroeder.

JERSEY CITY
James Ashworth.
West Bissell.
David R. Daly.
E. J. Donahue.
J. P. Henofer.
F. W. Schmidt.

LONG BRANCH
Fredk. R. M. Cutcheon.
L. E. DeQuine.

MORRISTOWN
Fredk. A. Lydecker.

New Jersey—(*Continued*)

NEWARK

Edward B. Annett.
William S. Barker.
William H. Chadwell.
John A. Clark, Jr.
J. S. De Hart.
E. H. Earnshaw.
H. H. Ferris.
A. J. Ford.
Ellsworth Francisco.
H. D. Gillingham.
W. M. Halsey.
J. P. Hanlan.
James N. Killgore.
Thomas N. McCarter.
J. G. O'Keeffe.
W. H. Pettes.
L. J. Platt.
O. F. Potter.
Otto Reiner.
Geo. J. Roberts.
J. McClellan Rogers.
Jas. R. Schurz.
Alexander H. Strecker.
Adolph Frederick Wehner.
Robert K. Wehner.
E. C. Weisgerber.
H. D. Whitcomb.
Percy S. Young.
R. R. Young.

NEW BRUNSWICK

J. C. Roberson.
S. K. Zook.

OCEAN CITY

A. H. Osborn.
Martin Maloney, 2d.

PASSAIC

Oliver H. Folger.

PATERSON

John Bimson, Jr.
Theo. Bunker.
Jas. M. Lane.
W. H. Rogers.
William L. Williams.

PERTH AMBOY

Geo. A. Balz.
H. Foersterling.
A. F. Reitmeyer.
J. Charles Ross.
Louis A. Witte.

PLAINFIELD

W. R. Causebrook.
Thomas L. Melick.

PRINCETON

John F. Hoff.

RIDGEWOOD

George S. Soult.

SUMMIT

M. S. Sherwood.

TOMS RIVER

B. H. Spangenberg.

TRENTON

Charles G. Cook.
James H. Galt.
Frank D. Moses.

WEST HOBOKEN

James Kennedy.

New York

ALBANY

F. S. Dunn.
Wm. G. Furlong.
John J. Garrison.
E. P. Gavit.
C. H. Graf.
Frederick J. Ikena.
Donald McDonald.
F. McDonald.
William McDonald.
R. E. Sard.
F. A. Scobel.

AMSTERDAM

G. D. Conlee.
W. H. Cooper.

New York—(*Continued*)

ASTORIA, L. I.
C. M. Carbonell.
F. J. Cotton.
H. H. Himsworth.
W. J. Hawthorne.
H. L. Jochum.
W. F. Lawrence.
M. E. Mueller.
John C. Shaw.
N. J. Sperling.
Crist H. Stevick.
A. H. Zane.

BINGHAMTON
Charles W. Bennett.

BROOKLYN
T. M. Ambler.
Frederick R. Baldwin.
Fred. S. Benson, Jr.
Charles Boone.
John H. Braine.
Robert Wilder Bush.
Edward J. Byrne.
Edward Louis Byrne.
Thomas E. Byrne.
George S. Callaway.
W. VanAlan Clark.
Charles A. Cross.
Charles Dougherty.
Guy K. Dustin.
Charles M. Ford.
Raymond L. Greene.
Theodore Haight.
G. S. Hendrickson.
A. B. Hohman.
W. A. Jack.
Edwin D. Jones.
James H. Jourdan.
R. C. Kellogg.
Thos. P. Kennedy.
W. W. Kunze.
John D. Logan.
Henry E. McGowan.
R. MacSaveny, Jr.
E. H. Mathews.
Samuel A. Mills.
Albert F. Murphy.
E. J. Murphy.
A. H. Schaaf.
J. Fred Seamon.
Samuel V. Seddon.
David J. Shepard.
S. W. Slater.
A. F. Staniford.
L. S. Stiles.
Andrew J. Voorhees.
W. M. Wepfer.
John T. White.
Prescott B. Wiske.
W. P. Woodroffe.
Edward C. Uhlig.
H. A. Wuest.

BUFFALO
Lucius S. Bigelow.
J. E. Burke.
H. C. Palmer.
Walter W. Richardson.
William S. Riselay.

CANANDAIGUA
V. A. Miller.

CONEY ISLAND
Harry J. Dillon.
Geo. Herbert Woodall.

FAR ROCKAWAY
Edw. L. Davies.
L. A. Howland.
Carlton Macy.
Edward H. Marsh.
J. C. Sheehy.

FLUSHING
M. H. Spear.
Edw. J. Sullivan.
W. H. Sullivan.

GENEVA
E. H. Palmer.

New York—(*Continued*)

Glens Falls

H. M. Collin.
John Owens.

Gloversville

John G. Felton.
Louis C. Smith.

Hempstead

O. J. A. Lundblad.
W. W. Nissley.

Ithaca

James W. Murdock.

Kingston

R. F. Chidsey.
Franklin Tobey, Jr.

Little Falls

Henry P. Collins.

Long Island City

C. Cassels Atwood.
Clifford S. Fox.
O. H. Smith.
Harry L. Snyder.
C. G. M. Thomas.

Middletown

C. H. Stone.

Mt. Vernon

G. E. Bennitt.
Chas. F. Bryant.
William J. Clark.
Sidney S. Coles.
Edgar B. Davis.
J. W. Green.
Robert James Jennings.
Alfred M. Keene.
R. M. Kellogg.
George T. Macbeth.
Martin Morrison.
W. L. Secord.
Stanley G. Tarrant.
Stuart Wilder.

Newburgh

A. R. Beal.
G. H. Smith.

New York City

H. C. Abell.
Walter R. Addicks.
A. B. Allen.
H. E. Almberg.
H. W. Alrich.
J. Charles Andrews.
J. H. N. Armstrong.
C. G. Atwater.
C. T. Ayres.
A. C. M. Azoy.
T. S. Barlow.
W. W. Barnes.
F. H. Barnitz.
William E. Barrett.
Wm. F. Barrett.
W. H. Barthold.
Eugen Becher.
Edward A. Behringer.
E. W. Bell.
W. Russell Bogart.
William H. Bradley.
James C. Brady.
Ernest C. Brown.
H. M. Brundage.
Martin F. Buckley.
J. H. Budde.
D. M. Bull.
Sterling H. Bunnell.
Thos. J. Byrne.
Elbert P. Callender.
S. K. Campbell.
Frank Carpenter.
Harold Carpenter.
Robert A. Carter.
Robert A. Carter, Jr.
Joseph L. de Castro.
Dr. Chas. F. Chandler.
C. H. B. Chapin.
E. S. Chapin.
Frank P. Cheesman.
W. A. Clader.
B. C. Cobb.
W. W. Cole.
Francis Colton.

New York—(*Continued*)

NEW YORK CITY

James P. Conroy.
Horace G. Cooke.
Marshall Cornine.
George B. Cortelyou.
William M. Crane.
John J. Creeden.
Philip Cross.
H. R. Crowell.
William DeFreitas.
Frederick R. DeVoe.
J. Alfred Dixon.
R. M. Dixon.
George W. Doane.
Henry L. Doherty.
Chas. Dougherty.
F. J. Down.
Philip Dunne.
W. K. Eavenson.
A. B. Eilbeck.
Arthur H. Elliott.
Charles B. Elmer.
J. R. Fenniman.
Wm. M. Flook.
James R. Floyd, Jr.
O. H. Fogg.
Alfred E. Forstall.
Charles G. Francklyn.
Gilbert Francklyn.
Frank W. Frueauff.
Lewis B. Gawtry.
C. J. Gefvert.
Patrick Goodman.
W. R. Goudy.
Malcolm M. Graham.
Orange G. Griffin.
C. A. A. Griffiths.
Norman J. Griffiths.
F. E. Haag.
A. H. Hall.
Joseph B. Hare.
W. K. Harrington.
W. P. Hayes.
Harold A. Hayward.
Sterling F. Hayward.
Frederick D. Herbert.
C. M. Higgins.
Willard F. Hine.
Walter H. Hinman.
Chas. H. Hodges.
Frederic deP. Hone.
David Leavitt Hough.
Abram C. Howard.
William Greely Hoyt.
D. S. Hudson.
Alexander C. Humphreys.
F. W. Humphreys.
Jas. F. Hunter.
Edward B. Hyde.
H. B. Hyland.
Charles W. Isbell.
C. N. Jelliffe.
Adolph C. Johnson.
Mervyn E. Johnston.
P. R. Jones.
Edward R. Jourdan
Julius Kahn.
C. F. Keegan.
Wm. D. Kelley.
James S. Kennedy.
A. G. King.
I. C. Kingsbury.
I. Clayton Kingsbury
M. Kirchberger.
Paul Kruger.
Alanson P. Lathrop.
Albert Lauber.
C. F. Leonard.
Robert E. Livingston
Edward G. Love.
Charles E. Lucke.
Robert O. Luqueer.
Joseph Lush.
E. A. Lyon.
J. M. McCarthy.
J. W. McClellan.
William McClellan.
Isaac McGraw.
Wm. J. McGurty.

New York—(*Continued*)

NEW YORK CITY

W. N. McIlravy.
H. B. McLean.
Emerson McMillin.
Marion McMillin.
Norman Macbeth.
George MacDonald.
W. L. MacIntosh.
A. Fred Macklin.
D. T. MacLeod.
J. H. Mansfield.
F. C. Martineau.
John A. Mason.
J. Alex. Mayers.
Giles W. Mead.
Preston S. Millar.
Alten S. Miller.
Robert C. Miller.
L. B. Moorhouse.
Clarence P. Morrell.
W. Cullen Morris.
William G. Morris.
G. P. Morrow.
E. A. Nelson.
John F. Nelson.
Franklin H. Nickerson.
Edwin North.
John O'Connell.
M. Webb Offutt.
Alva L. Palmer.
Harry M. Papworth.
George W. Parker.
G. W. Parkhurst.
A. Parshall.
H. L. Peden.
Irwin W. Peffly.
J. H. Perkins.
C. Pilz.
C. C. Potter.
Daniel J. Prendergast.
Charles Raabe.
George G. Ramsdell.
William W. Randolph.
Wm. T. Rasch.
P. F. Reichhelm.
Hugo B. Reinach.
James F. Reynolds.
Wm. H. Rhoads.
Daniel Riordan.
Arthur R. Ritchie.
Chas. D. Robison.
Robert R. Rust.
T. V. Salt.
Eugene Y. Sayer.
E. H. Schmidt.
Philip J. Schneider.
C. S. Schroeder.
Thomas Scofield.
Thomas Shaughnessy, Jr.
Richard Shepard.
Marvin Shiebler.
C. C. Simpson.
Henry Simpson.
G. O. Smith.
Elliott L. Spencer.
R. E. Sperry.
Arthur W. Stark.
John Stilwell.
G. W. LeR. Travis.
Lucien P. F. Tull.
Alfred E. Turner.
H. L. Underhill.
A. Van den Driessche.
W. H. Van Winkle.
George H. Warner.
Albert J. Weber.
F. C. Weber.
T. G. Weber.
Louis H. Werner.
M. C. Whitaker.
Benjamin Whiteley.
R. M. Wilson.
Louis Wilputte.
G. J. Wilson.
S. E. Wolff.
George E. Woods.

NIAGARA FALLS

Albert H. Merritt.

New York—(*Continued*)

NYACK
E. C. Peebles.

OSSINING
O. G. Bennett.
Riley W. Farr, Jr.
H. W. Terry, Jr.

OSWEGO
E. R. Morse.
R. F. Whitney.

OWEGO
A. P. Storrs.
Chas. P. Storrs.

PENN YAN
Wm. T. Morris.

PLATTSBURG
George M. Cole.

PORTCHESTER
J. K. Crowell.
Joseph P. Kane.

PORT WASHINGTON
John E. Bullard.

POUGHKEEPSIE
T. R. Beal.
Hugh M. Beugler.
L. H. Scherck.

ROCHESTER
J. C. Collins.
James B. Eaton.
Joseph P. Haftenkamp.
Frank Hellen.
James T. Hutchings.
I. Lundgaard.
Joseph P. MacSweeney.
Herman Russell.
Karl A. Schick.
E. C. Scobell.
Robert M. Searle.
C. A. Tucker.

ROME
H. W. Mitchell.
A B. Morton.

RYE
J. K. Crowell.

SARANAC LAKE
Charles A. Gruber.

SARATOGA SPRINGS
Patrick F. Roohan.

SCHENECTADY
Wm. A. Tobias.
Henry W. Peck.
V. vonStarzenski.

SENECA FALLS
R. C. Lewis.

STAPLETON
John J. Callahan.
W. M. R. Hammond.
H. Muller, Jr.
William J. Welsh.

SYRACUSE
William H. Blauvelt.
James C. DeLong.
S. J. Dickey.
Arthur D. Dudley.
W. D. Scott.
S. C. Singer.
L. M. Whitwell.
Edwin C. Witherby.

TARRYTOWN
Ernest R. Conover.
H. B. Kellogg.
John A. Neth.

TROY
James H. Caldwell.
W. C. Coleman.
Henry C. Shields.

UTICA
William J. Cahill.
Herbert Gilmore Johnson.

WATERTOWN
Fred A. Rogers.
John B. Taylor.
Peter Young.

New York—(*Continued*)

WESTCHESTER

John D. Alden.
J. M. Butler.
Eugene H. Rosenquest.

WHITE PLAINS

John Malakoff.
E. S. Martin.

YONKERS

E. O. Baxter.
J. E. Galligan.
A. M. Knapp.
Herbert Sherwood.
Charles F. Timm.
Wm. G. Wright.

North Carolina

ASHEVILLE

H. W. Plummer.

GREENSBORO

Charles H. Andrews.

NEW BERN

F. H. Sawyer.

RALEIGH

S. P. Cobb.

ROCKY MOUNT

J. B. Cocke.

WINSTON-SALEM

B. N. Sullivan.

Ohio

ALLIANCE

D. W. Low.

ASHTABULA

Frederick W. Stone.

BUCYRUS

H. O. Dutter.

CHILLICOTHE

Frederick A. Stacey.

CINCINNATI

A. E. Call.
William A. Miller.
Andrew J. Stacey.
James E. Stacey.

CLEVELAND

D. K. Crighton.
C. S. Eaton.
H. C. Fritz.
C. C. Gartland.
Frank R. Hutchinson.
Edward P. Hyde.
William H. Knight.
Melvin Pattison.
A. T. Perry.
C. H. Printz.
W. E. Steinwedell.
Frank E. Taplin.
Daniel R. Warmington
J. G. Way.

COLUMBUS

Thomas J. Jones.
William R. Powell.
Henry D. Turney.

DAYTON

Edward H. Light.
George Light.
W. W. Price.
Frank M. Tait.

DELAWARE

Thomas Clive Jones.

HAMILTON

Lazard Kahn.

MANSFIELD

William C. Hedges.

MARION

George Whysall.

MIDDLETOWN

G. F. Ahlbrandt.

NEWARK

Melville Gillett.

WARREN

George Daugherty.

YOUNGSTOWN

Fred S. Coombs.
W. E. Manning.
G A. Reinhardt.

Oklahoma

McAlester
F. A. Willard.

Muskogee
H. H. White.

Oregon

Portland
W. B. Foshay.
Elmon L. Hall.
Hilmar M. Papst.

Pennsylvania

Allentown
J. Ward Crankshaw.
John A. Frick.
A. C. Taylor.

Ardmore
Leon B. Eichengreen.
Howard Hoffman.
Isaac N. Knapp.
John L. Mather.

Berwick
L. D. Spragle.

Bethlehem
W. F. Brodnax.
R. C. Morris, Jr.
G. A. Neal.

Bolivar
N. A. Young.

Bradford
George P. Boothe.
Fred A. Miller.

Carbondale
Chas. L. Rowland.

Catasauqua
G. W. Steele.

Chester
Hugh C. Aiken.
L. D. Huestis.
J. D. Shattuck.
George W. Thomson.
Wm. M. White.
Charles Wilde.

Clearfield
Warren Partridge.

Coatesville
A. P. McCarthy.

Collingdale
Thomas B. Tinney.

Colmar
R. H. Dutton.

Darby
Charles J. Fox.

Easton
B. F. Cresson.
Edwin G. Holzer.

Erie
F. H. Payne.

Hamburg
A. J. Althouse.

Harrisburg
C. M. Cole.
C. M. Kaltwasser.
Luther S. Williams.

Irwin
Edwards F. Wilson.

Kennett Square
G. J. Maloney.

Kingston
H. G. Williams.

Lebanon
Geo. S. Speaker.

Lewiston
Frank P. Duggan.

Norristown
H. B. Bryans.
Herbert H. Ganser.
W. N. Tolman.

Philadelphia
H. C. Adams.
E. R. Alburger.
Walter A. Allison.
Howard B. Andersen.
James Ball.

Pennsylvania—(*Continued*)

PHILADELPHIA

Geo. J. Barnes.
Geo. S. Barrows.
Henry S. Battin.
Wm. P. Baylie.
Albert B. Beadle.
Walter W. Beaumont.
Samuel Taylor Bodine.
Charles O. Bond.
Cyrus Borgner.
Albert M. Boyd.
C. A. Braun.
Wm. L. Brown.
Charles L. Bruff.
Joseph Butler.
Ervin Calhoun.
F. A. Canon.
E. G. Carlisle.
Henry R. Cartwright.
William A. Castor.
Walter L. Chewning.
Charles J. Clark.
Walton Clark.
A. L. Collins.
David J. Collins.
E. M. Colquhoun.
H. R. Cook, Jr.
R. C. Cornish.
J. A. P. Crisfield.
W. T. Crouse.
A. R. Cruse.
G. W. Curran.
Samuel P. Curtis.
R. E. Dallas.
P. T. Dashiell.
H. W. Davies.
William F. Dorner.
James B. Douglas.
W. F. Douthirt.
Ronald B. Duncan.
W. G. Earnshaw.
W. M. Ellenberger.
Owen B. Evans.
Samuel E. Fairchild, Jr.
Walton Forstall.
J. Scott Fowler.
F. C. Freeman.
Walter H. Fulweiler.
William H. Gartley.
Clarence H. Geist.
Thomas S. Genay.
T. C. Gibbs.
Francis H. Gilpin.
H. W. Graeff.
Albert W. Grant, Jr.
Albert Green.
John Gribbel.
W. Griffin Gribbel.
Rowland E. Griffis.
H. O. Gross.
Clifford L. Haldeman.
Charles F. Hardick.
C. Willing Hare.
Geo. M. Harrison.
William E. Helme.
G. R. Hemminger.
J. H. Hubbs.
Herbert E. Ives.
Thos. H. Jackson.
Robert C. James.
C. C. Jones.
Edwin P. Jones.
William Kane.
R. L. Klar.
August C. Klein.
John Bartleman Klumpp.
D. S. Knauss.
P. J. Lafore.
W. P. Lane.
Louis R. Lemoine.
Lewis Lillie.
H. Livingston.
John McIlhenny.
John D. McIlhenny.
Andrew P. Maloney.
William H. Marshall.
Sidney Mason.
P. C. Mayfield.
James B. Mingus.

Pennsylvania—(*Continued*)

PHILADELPHIA

F. N. Morton.
Wayne R. Moyer.
H. P. Murphy.
Joseph B. Myers.
H. H. Nevanas.
Carroll B. Nichols.
Rollin Norris.
C. J. O'Donnell.
William H. Parish.
Joseph Smith Parker.
J. A. Pearson.
Harry G. Peck.
H. P. Penfield.
M. F. Perkins.
Rowan P. Perkins.
Jos. A. Perry.
H. W. Plucker.
Edward Porter.
John V. Postles.
Clarence V. Roberts.
Chauncey D. Robinson.
Edward H. Rodgers.
Robert J. Rolston.
William L. Rowland.
John M. Ruegenberg.
John M. Rusby.
James Russell.
F. J. Rutledge.
Carl A. Schlegel.
H. S. Schutt.
Harold K. Seeley.
William J. Serrill.
A. E. Shaw.
Howard R. Sheppard.
George L. Smith.
J. H. Smith.
Charles S. Snyder.
Jacob W. Stirzel.
L. J. Strause.
Morris W. Stroud.
Walter Sturdevant.
J. Hawley Taussig.
P. D. Taylor.
Nathaniel W. Thomas.
Paul Thompson.
Fred G. Thorn, Jr.
Carrington Cabell Tutwiler.
E. P. Walter.
Chas. P. Warner.
J. H. Warnick.
John S. Welch.
D. B. Wentz.
F. V. Westermaier.
Henry Wharton.
Walter Whetstone.
Robert H. Whipple.
Edward R. Wood, Jr.
Wm. M. Wood.

PHOENIXVILLE

Charles Waldron, Jr.

PITTSBURGH

Arthur Booth.
Alfred P. Brill.
H. A. Carpenter.
Albert G. Davis.
Charles D. Evans.
R. C. Frampton.
J. E. Gill.
Joseph F. Guffey.
William H. Hammon.
Edw. D. Leland.
T. L. Lewis.
Walter L. McCloy.
J. C. McDowell.
Wm. McKee.
C. S. Mitchell.
John J. Murray.
G. R. Nutty.
R. G. Porter.
James H. Reed, Jr.
Joseph A. Reed.
Edwin Ruud.
W. F. Schell.
Kenneth Seaver.
Thomas J. Smith, Jr.
Frank N. Speller.
Samuel B. Stewart.

Pennsylvania—(*Continued*)

PITTSBURGH
Wm. W. Weller.
Robert W. H. Young.
R. H. Youngman.

READING
George B. Bains, 3d.
John H. Keppelman.

SCRANTON
Worthington Scranton.
Harold N. Squier.
E. M. Stack.

SUNBURY
George W. Beck.

WEST CHESTER
William O. Lamson, Jr.

WILKES-BARRE
Wm. C. Anderson.

WILLIAMSPORT
Ernest H. Davis.
Wm. R. Rhoades.

WYNCOTE
N. B. Bertolette.
L. R. Dutton.

YORK
Joseph E. Philbrick.

Rhode Island

NEWPORT
A. K. Quinn.

PAWTUCKET
William McGregor.
John E. Morgan.
E. I. Patt.

PROVIDENCE
George E. Allyn.
W. C. Buell, Jr.
Edmund Cathels.
John W. Ellis.
A. L. Harris.
T. H. Hintze.
Roger W. Polk.
W. H. Price.
C. G. Richardson.
R. E. Slade.

SLOCUMS
A. B. Slater.

WOONSOCKET
Alfred F. Townsend.

South Carolina

CHARLESTON
C. M. Benedict.
P. H. Gadsden.
Edward C. Kollock.
G. H. Waring.

COLUMBIA
S. W. Brown.

SPARTANBURG
J. A. Callenbach.

South Dakota

ABERDEEN
Charles A. Howard.

DEADWOOD
H. H. Hyde.

MITCHELL
E. J. Sherwood.

SIOUX FALLS
M. L. Kane.
S. E. Linton, Jr.

Tennessee

CHATTANOOGA
S. E. DeFrese.

KNOXVILLE
Alfred W. Young.

MEMPHIS
L. G. Van Ness.

NASHVILLE
Roger B. Combs.
G. Maxwell Johnson.
B. V. Pfeiffer.

Texas

ABILENE
G. H. Caffrey.
A. V. Wainwright.

Texas—(*Continued*)

BEAUMONT
M. T. Walker.

DALLAS
Henry C. Morris.

EL PASO
Keating Lewis Simons.

SAN ANTONIO
G. H. Cushman.
E. E. Eysenbach.
E. B. Henson.
W. B. Tuttle.

Utah

PROVO
F. W. Freese.

SALT LAKE CITY
John C. D. Clark.
H. C. Estberg.
Wm. R. Putnam.

Vermont

BURLINGTON
David W. Jardine.
Frank H. Parker.

TYSON
J. J. Humphreys.

Virginia

BIG STONE GAP
Otis Mouser.

CHARLOTTESVILLE
H. M. Hantzmon.

DANVILLE
Frank Talbott.

FREDERICKSBURG
B. F. Bullock.

LYNCHBURG
Albert J. Kohler.
Ward Wilson.

NEWPORT NEWS
W. F. Croston.

NORFOLK
E. C. Hathaway.
R. J. Marks.

PETERSBURG
R. A. Goudy.

PORTSMOUTH
B. B. Ferguson.

RICHMOND
William P. Knowles.
W. H. Matlack, Jr.
G. E. Tozier.
W. W. Vetters.

ROANOKE
M. M. Milton.

SUFFOLK
Chas. H. Brown.
J. Edw. Francis.

Washington

ABERDEEN
P. A. Bertrand.
Norman Smith Burcombe.

NORTH YAKIMA
W. A. Bertke.

SEATTLE
Edward A. Dieterle.
N. C. Fancher.
Frederick K. Lane.
A. F. Mueller.

SPOKANE
H. B. Kircher.

TACOMA
W. A. Leuenberger.
William W. Seymour.

WENATCHEE
Arthur Gunn.

Wisconsin

BELOIT
Philip S. Dickey.
Robert G. Krumrey.
B. F. Lyons.

Wisconsin—(*Continued*)

JANESVILLE
I. F. Wortendyke.

MADISON
C. F. Burgess.
John Corscot.
F. L. Cross.
Wiley J. Huddle.
O. L. Kowalke.
John St. John.

MANITOWOC
J. P. Eastman.

MILWAUKEE
John F. Blackie.
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Alabama	6	Ohio	39
Arkansas	1	Oklahoma	2
California	44	Oregon	3
Colorado	7	Pennsylvania	235
Connecticut	33	Rhode Island	16
Delaware	1	South Carolina	6
District of Columbia	9	South Dakota	5
Florida	11	Tennessee	6
Georgia	18	Texas	9
Idaho	2	Utah	4
Illinois	124	Vermont	3
Indiana	43	Virginia	18
Iowa	27	Washington	11
Kansas	5	Wisconsin	33
Kentucky	10	Belgium	1
Louisiana	5	Canada	12
Maine	9	Cuba	2
Maryland	19	England	11
Massachusetts	80	Hawaii Territory	1
Michigan	65	Japan	6
Minnesota	14	Mexico	1
Mississippi	2	Netherlands	1
Missouri	38	New Zealand	1
Montana	4	Philippine Islands	1
N braska	7	Porto Rico	1
New Hampshire	5	South America	2
New Jersey	97	Switzerland	1
New York	406		
North Carolina	6	Total	1,528

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